2026 South Dakota Pest Management Guide

Alfalfa and Oilseeds

A guide to managing weeds, insects and diseases.

Photo by Adam Varenhorst

South Dakota State
University Extension

Pesticide Recertification Information

The South Dakota Department of Agriculture and Natural Resources (DANR) is the lead agency administering the pesticide certification program required by the Federal Insecticide, Fungicide, and Rodenticide Act (FIFRA). SDSU Extension partners with DANR to offer training programs. Those who apply pesticides for hire or as an employee that applies pesticides while performing work duties, must have a commercial applicator license. Existing applicators may complete recertification online.

Commercial Aplicator Information: https://extension.sdstate.edu/south-dakota-commercial-pesticide-applicator-certification-testing

Private Applicator Information: https://extension.sdstate.edu/applicator-training-pesticides

Contact: Stephen Robertson, SDSU Extension Pesticide Education Field Specialist, stephen.robertson@sdstate.edu , (605) 688-5550

Safety First

Follow the Label. It is a violation of federal pesticide laws to use a pesticide in a manner inconsistent with its labeling. Read the entire label before using.

Applicator Safety. The most serious risk of exposure is during handling and mixing the concentrated product. Use protective equipment specified on the label. Use chemical-resistant gloves, eye shield, long-sleeved clothing, rubber boots and appropriate respirator as required. In case of emergency, contact the Poison Control Center via 24-hour phone line:

Poison Control Center – 1-800-222-1222

Water Protection. Water quality is a public concern. Preventing spills and accidents reduces risk of groundwater and surface water contamination. Mix pesticides away from wells and water sources. Prevent back siphoning. Install anti-backflow devices in irrigation equipment used for pesticides. Triple rinse containers. Store pesticides properly. Identify high-risk areas such as coarse soils or areas where the water table is near the surface. Be aware of pesticide properties that increase the risk of contamination in the critical area. Some treatments have specific restrictions requiring buffer strips and border areas around wells, lakes and streams.

Trade names for pesticides are used in this publication to aid reader recognition. The common name is also listed and is used for pesticides that are available in many labeled products. Examples of other product names are listed where possible based on information available. As patents expire and marketing agreements are formed, additional products may be marketed. Be sure crop use and application directions are followed for the product being used.

This book was published by SDSU Extension. For more information in the fields of agriculture, farming and rural living available in print, electronically or on-line, visit extension.sdstate.edu.

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Information in this book is intended to be a guideline for label information and is not a label substitute. Pesticide products include herbicides, insecticides and fungicides. Pesticide product labels can change at any time and applicators must follow all label procedures. It is particularly important to be sure pesticide products are being applied in the correct environments (e.g. right-of-way, pasture, cropland, non-crop, etc.), environmental precautions are being followed (rate restrictions, applications on or near surface water or shallower water tables, applications near trees, etc.), and in accordance with grazing/haying restrictions.

This resource is presented for informational purposes only. SDSU does not endorse the services, methods or products described herein, and makes no representations or warranties of any kind regarding them.

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South Dakota 2026 Pest Management Guide – Alfalfa and Oilseeds

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Abbreviations Used

oz = ounce
pt = pint
qt = quart
gal = gallon
lb. = pound
gpa = gallon per acre
lb./gal = pound per gallon
fl oz/a = fluid ounce per acre
A = acre
L = liquid or EC
G = granule
DF = dry flowable (spray)
EC = emulsifiable concentrate
ai = active ingredient
ae = acid equivalent
AMS = ammonium sulfate
COC = crop oil concentrate
MSO = methylated (processed) seed oil
NIS = non-ionic surfactant
PHI = pre-harvest interval
REI = restricted entry interval
SG = soluble granule
WDG = water dispersible granule
WSP = water soluble packet
XP = extruded paste
UAN = Urea + ammonium nitrate liquid fertilizer
%v/v = percent volume per volume

Weed Control in Alfalfa and Forage Legumes

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Vigorous forage plants are good weed competitors. Quality seed, proper seedbed, and good planting techniques will reduce weed problems in new legume seedings. Herbicides are an aid to recommended within grazing or haying practices.

Herbicide Suggestions: Information in this publication is based on research conducted by the South Dakota Agricultural Experiment Station and other research or observations. Herbicides are included only after registration by the Environmental Protection Agency (EPA).

This information provides a summary of herbicide uses and does not imply a guarantee or responsibility for results. Trade names are for reader convenience and do not imply product endorsement. Users are responsible for following label directions and precautions.

Most herbicides are listed by trade name except where the active ingredient is available in several products. The common name (in parentheses) follows the first listing of the trade name. Product labels for the same active ingredient may vary. Users should consult the label of the product.

Rates for each treatment and each formulation are stated as the amount of product per acre. Weed control is rated poor, fair, good, very good, or excellent for each weed problem in each crop.

Herbicide Cost: The cost per acre for herbicide treatments is given using suggested retail prices for the low and high rates. Consult your local dealer for actual prices.

Group Numbers Associated with Herbicide Sites or Modes of Action

WSSA Group Number	Site or Mode of Action	Examples
1	ACCase inhibitor	clethodim, sethoxydim
2	ALS inhibitor	imazamethabenz, imazamox
3	Microtubule inhibitor	pendimethalin, trifluralin
4	Growth regulator	clopyralid, MCPA
5	Photosynthesis inhibitor (triazine)	metribuzin, hexazinone
6	Photosynthesis inhibitor (contact)	bentazon, bromoxynil
7	Photosynthesis inhibitor (urea)	diuron
8	Lipid synthesis inhibitor (thiocarbamates)	EPTC
9	EPSP inhibitor	glyphosate
14	Cell membrane disrupter (PPO inhibitor)	sulfentrazone
22	Cell membrane disrupter (PSI inhibitor)	paraquat

HERBICIDES FOR ESTABLISHED LEGUMES

HERBICIDES FOR ESTABLISHMENT WITHOUT COMPANION CROP

HERBICIDE TOLERANT ALFALFA

Herbicides for Established Legumes

Established legumes can compete effectively with most annual weeds. However, weeds can become established in thin, weak legume stands. Winter annual weeds, such as pennycress or downy brome, become a problem when fall conditions are favorable for establishment. Perennials, such as dandelion or perennial grasses, often persist despite legume competition.

Controlling weeds will not improve the legume stand and may not increase total forage production. However, weed control usually improves protein percentage and palatability of harvested forage. Drying time may be reduced when weeds are not present in the forage.

Weed control has greatest value if there is a premium for high quality, pure legume forage. Weed control in seed fields reduces cleaning problems and yields higher quality seed.

METRIBUZIN PRODUCTS *(metribuzin)* Site of Action: 5 **($4.35–26.25)**

0.33 – 1.33 lb. Dimetric EXT, Derive, Glory, Metribuzin 75, Metricor DF, Me-Try-Buzin, Metrixx, Tricor 75DF (0.25 – 1.0 lb. ai)
0.66 – 2.66 pt Dimetric 3L (0.25 – 1.0 lb. ai)
0.5 – 2 pt Tricor 4F, Glory, Metricor 4F, Me-Try-Buzin, Metrixx SC 4L (0.25 – 1.0 lb. ai)

Alfalfa and sanfoin only. Apply to fields that have been established for at least one year. May be used on mixed alfalfa and grass stands; however, injury to grasses should be expected. Higher rates may cause severe damage to forage grasses. Metribuzin gives good to excellent control of many annual and some biennial or perennial weeds including kochia, shepherd's-purse, tansy mustard, blue mustard, and downy brome ("cheatgrass"). Dandelion control has been fair, but variable. Seedling dandelion control is very good.

Crop tolerance is good. There is some risk of injury with high rates on light soil. Do not use on sandy soils. There are no pH limitations; however, there is increased risk of injury on very high pH soils. Crop injury may occur when crop is under stress such as disease, insect infestations, drought, poorly drained soils or winter injury or if crop is treated within 12 months after seeding. Crop injury may occur if there is excessive irrigation or rainfall immediately after application. Do not apply more than ½ inch of water in the first irrigation after application.

Rates of 0.66 – 1.33 lb./A (75DF), 1.33 – 2.66 pt (3L), or 1 – 2 pt (4L) are suggested for annual broadleaved weeds. A rate of 0.5 – 0.66 lb./A (75DF), 1 – 1.33 pt (3L), or 0.75 – 1 pt (4L) is adequate for downy brome. Use 1.33 lb./A (75DF), 2.66 pt (3L), or 2 pt (4L) for bluegrass, barnyardgrass, or dandelion. Carrier is 10 – 40 gpa for ground and a minimum 2 gpa for air. Alfalfa, corn, forage grasses, and soybeans may be planted 4 months after application. Other crops may be planted 18 months after application.

FALL or SPRING: Apply in late fall after cutting when fall growth has ceased or in early spring before growth begins. Fall application strongly preferred; however, early spring applications have provided excellent downy brome control. Active legume growth at the time of application will be damaged. Do not graze for 28 days after treatment.

POAST *(sethoxydim)* Site of Action: 1 **($16.60–41.50)**

1–2.5 pt Poast 1.5L (0.2–0.5 lb. ai)

Established pure stands of alfalfa, birdsfoot trefoil, and sanfoin. Grasses in a mixture will be killed or damaged. Used primarily in established stands to control annual and perennial grasses. Applications are not effective on downy brome.

Poast rates are 1 pt for foxtail, 1.5 pt for sandbur and 2.5 pt/A for quackgrass. Repeat application required for improved quackgrass control.

Add COC at 2 pt/A. The addition of 0.5 to 1 gal 28% or 2.5 lb. AMS per acre improves control of some grasses. Minimum carrier is 5 gpa for air or ground; increasing carrier to 10 gpa may improve results if growth is dense.

POSTEMERGENCE: Apply to actively growing weeds. Refer to section for new seedings for additional information. Do not harvest wet forage or graze for 7 days. Do not cut for dry hay for 14 days after treatment.

CLETHODIM PRODUCTS *(clethodim)* Site of Action: 1 **($3.15–32.40)**

10 – 16 oz Select, Arrow, Avatar, Cleanse, Clethodim, Dakota, Gatlin, Intensity, Shadow, Trizenta, Vaquero, or Volunteer 2EC (0.16 – 0.25 lb. ai)
12 – 32 oz Select Max, Tapout, or Intensity One 0.97L (0.09 – 0.25 lb. ai)
4 – 10.7 oz Section Three, Trizenta 3EC or Shadow 3EC 3L (0.09 – 0.25 lb. ai)

Established pure stands of alfalfa, birdsfoot trefoil, and sanfoin. Grasses in a mixture will be killed or damaged. Clethodim controls several annual grassy weeds. Provides effective control for downy brome, foxtail barley, and sandbur.

Lower rates are for small annual grasses. Minimum carrier is 5 gpa ground, 3 gpa air. Add a surfactant and AMS at 2.5 – 4 lb./A. Individual labels vary on surfactant recommendations with most suggesting COC at 1% v/v or 1 qt/A.

POSTEMERGENCE: Apply to actively growing weeds. Crop may be grown for seed, hay, silage, or direct grazing. Do not apply within 15 days of harvest or grazing.

IMAZETHAPYR PRODUCTS *(imazethapyr)* Site of Action: 2 **($12.10–24.20)**

3 – 6 oz Pursuit, Praxis, Pemex, Imazethapyr, Thunder, Tronido 2L (0.047 – 0.094 lb. ai)

Alfalfa and clover. Established grass will be damaged. Pursuit gives excellent control of pennycress, pigweed, Russian thistle, and nightshade. Imazethapyr products will control cocklebur, kochia, and sunflower if the populations are not resistant to ALS-inhibiting herbicides. Established dandelion, downy brome, sandbur, quackgrass, Canada thistle, and field bindweed are not satisfactorily controlled. Considerable early–season growth and flower suppression of established dandelion plants has been noted in SDSU tests.

Crop tolerance is very good. There are no soil pH or soil texture restrictions. The 3 oz rate has been satisfactory for mustards and other susceptible weeds. During the last year of the stand do not apply more than 4 oz/A.

Minimum carrier is 10 gpa; use 20 gpa for high weed pressure or if residue is heavy. Add NIS at 0.25% or 1.25% v/v COC or 1% MSO plus UAN or AMS.

May be tank-mixed with other labeled herbicides including 2-4-DB, Select, or Poast. When tank-mixing, follow additive guidelines according to the product label. Follow rotational crop guidelines for succeeding crops. If a stand is lost after application, allow a 4-month interval before planting alfalfa.

DORMANT–FALL or SPRING: Apply in late fall after the last cutting and crop is dormant or in the spring before alfalfa or clover has 3 inches growth.

POSTEMERGENCE: Apply after alfalfa cutting to actively growing weeds (less than 3 inches) after alfalfa has reached second trifoliate. Do not graze or harvest alfalfa or clover for 30 days after application.

BEYOND XTRA, RAPTOR, IMIFLEX, IMAZAMOX, OCTIVIO, or VULTURE *(imazamox)* Site of Action: 2 **($14.30–28.10)**

4 – 6 oz Beyond Xtra, Raptor, ImiFlex, Imazamox, Octivio, or Vulture 1L (0.031–0.047 lb. ai)

Alfalfa only. Established grass will be damaged. Imazamox products control several annual broadleaf and grass weeds. Imazamox products will control cocklebur, kochia, and sunflower if the populations are not resistant to ALS-inhibiting herbicides. Suppression of certain perennial grasses. Rates are based on weed height and species. Weeds should be actively growing and not exceed 3 inches. Minimum carrier is 10 gpa for ground or 5 gpa for air; use 20 gpa for high weed pressure. Use COC, MSO, HSOC or NIS and 28% N or AMS.

Do not apply more than 6 oz/A per season or make more than one application per season. Do not apply sequential applications of imazethapyr followed by imazamox (or imazamox followed by imazethapyr) within 60 days or increased crop response may occur. Raptor may be tank–mixed with 2,4-DB, Poast, or Select. Check tank-mix partners for additives.

DORMANT–FALL or SPRING: Apply in late fall after last cutting and when crop is dormant or in the spring before alfalfa has 3 inches of growth.

POSTEMERGENCE: Apply after alfalfa cutting but before significant alfalfa regrowth (3 in) to allow herbicide to reach target weeds. Apply before bud formation on seed crop.

BUTYRAC 200 or 2,4-DB 200 (2,4-DB) Site of Action: 4 **($7.85–34.40)**

2 – 6 pt Butyrac 200 or 2,4-DB 200 2L (0.5 – 1.5 lb. ai)

Alfalfa, birdsfoot trefoil, red or white clover. For pure legume stands. Primarily for treating patches of problem weeds. Annual broadleaves such as cocklebur, lambsquarters, pennycress pigweed, and wild mustard are most susceptible. Common ragweed, shepherd's-purse, smartweed, and tansy mustard usually require higher rates. High rates will suppress top growth of perennial weeds such as Canada thistle. Not effective on established dandelion or kochia.

Some crop injury can be expected. Stem twisting and leaf malformation are usually noted. Use only the low rate on red clover. Do not treat when crop is under stress or if expected high temperature exceeds 90 degrees F.

Minimum carrier is 10 gpa for ground and 5 gpa for air.

FALL or SPRING POSTEMERGENCE: Apply when weeds have emerged and are actively growing. Weeds should be less than 3 inches tall for best results. Use when temperature is above 50 degrees F. Do not graze or harvest forage from treated areas for 30 days after applying.

MCPA AMINE *(MCPA Amine)* Site of Action: 4 **($3.65)**

1 pt MCPA Amine 4L (0.5 lb. ai)

Alfalfa labeled on some MCPA products. Apply in late fall to control biennial weeds after frost or to dormant alfalfa in spring.

Do not apply to actively growing alfalfa. Do not graze or forage for 7 days. Minimum water carrier is 2 gpa for air or 10 gpa for ground.

FALL or EARLY SPRING: Apply when temperature is above 40 degrees F for best control.

WARRANT *(acetochlor)* Site of Action: 15 **($14.60–23.40)**

1.25 – 2 qt Warrant 3L (0.94 – 1.5 lb. ai)

Alfalfa only. Application can be applied in the spring after green up in established stands or no later than 7 days after a cutting. Wait at least 20 days after application before haying or grazing.

May be tank mixed with several products for postemergence weed activity. May use up to two sequential applications however do not apply over 4 qt per season.

POST: Apply postemergence, however emerged weeds will not be controlled. Need to add a tank mix for post activity.

TRIFLURALIN PRODUCTS *(trifluralin)* Site of Action: 3

1.5 – 2 pt Treflan, Trifluralin, Triflurex, Trust 4L (0.75 – 1 lb. ai) **($6.10–13.60)**
20 lb. Treflan TR-10, Trifluralin 10G (2 lb. ai) **($22.20–34.75)**

Alfalfa only. Formulation and use may vary. Follow directions for product used. Use on stands established for at least one year. Provides good to excellent control of foxtail, barnyardgrass, and sandbur. Established downy brome will be controlled via tillage if mechanical incorporation is used in spring.

Excellent crop tolerance. Use is primarily in seed fields. Major concern is injury to crowns during incorporation. Liquid must be mechanically incorporated within 24 hours or may be applied via chemigation. Granules are activated by ½ inch of rain or overhead irrigation within 3 days of application or by mechanical means. A disk or field cultivator may be used. The program works well where alfalfa is planted in rows and row cultivation is used to incorporate.

Rates are 1.5 to 2 pt 4L or 20 lb./A of 10G. Rate of 2 qt/A may be used for application through irrigation systems. Minimum carrier is 5 gpa for ground or air.

SPRING: Apply before alfalfa growth begins and before weeds emerge.

FALL: Apply after cutting between August 1 and October 1. Primarily to control winter annual bromes that have not germinated.

SINBAR *(terbacil)* Site of Action: 5

0.5 – 1.5 lb. Sinbar 80W (0.4 – 1.2 lb. ai)

Alfalfa only. Use on pure stands established at least one year. Desirable perennial grasses may be injured or killed. Good to excellent control of many annual weeds including lambsquarters, pennycress, peppergrass, tansy mustard, downy brome and foxtail. Fair suppression of dandelion has been noted in SDSU tests. Perennial or established annual weeds are not controlled.

Crop tolerance is good on most soils. Avoid use in very sandy, gravelly, low organic matter (under 1%) soil. Rates of 1 to 1.5 lb./A Sinbar 80W have been used in most SDSU tests. Minimum carrier is 40 gpa for ground. Sinbar persists in the soil. Do not plant treated areas to other crops for 2 years after application.

FALL or SPRING: Fall applications strongly preferred; however, early spring applications have provided excellent downy brome control if rainfall is received soon after application.

VELPAR AlfaMax/AlfaMax Gold *(hexazinone + diuron)* Site of Action: 5 + 7 **($16.95–97.10)**

0.75 – 4.3 lb. Velpar AlfaMax 77.7 DF (0.26 – 1.5 + 0.32 – 1.8 lb. ai)
1 – 4.3 lb. Velpar AlfaMax Gold 78.5 DF (0.23 – 1 + 0.55 – 2.38 lb. ai)

DORMANT SEASON: Apply late fall to early spring to dormant alfalfa. Use rates based on soil texture and OM. Do not apply on fields with sandy loam or loamy sand soils having less than 1% OM. Do not apply within 30 days of harvest or feeding of forage or grazing. Do not exceed 4.3 lb./A (1.5 lb./A ai hexazinone) per year. Do not apply to stressed alfalfa as crop injury may occur. Do not apply to seedling alfalfa, alfalfa–grass mixtures, or other mixed stands as injury may result to seedling alfalfa or companion crop.

Velpar AlfaMax Gold may be tank mixed with other suitable herbicides and appropriate adjuvants registered for use in alfalfa. Refer to the tank mixture partner label(s) for any additional use information, precautions, or restrictions. Follow the label guidelines that are the most restrictive.

VELPAR or VELOSSA *(hexazinone)* Site of Action: 5 **($29.70–71.50)**

0.66 – 1.33 lb. Velpar 75DF (0.5 – 1 lb. ai)
2 – 4 pt Velpar 2L (0.5 – 1 lb. ai)
1.7 – 4 pt Velossa 2.4L (0.51 – 1.2 lb. ai)

Alfalfa established for at least one year. Perennial grasses will be severely damaged. The lower rates control pennycress, shepherd's purse, downy brome and foxtail. The high rate is required for perennial grass and established dandelion. Crop tolerance has been adequate.

Rates are adjusted for soil texture and OM. On medium and fine soils do not use more than 1.33 lb./A (DF) or 4 pt/A (L). Can apply up to 2 lb./A (DF) or 5–6 pt/A (L) on coarse soils with >5% OM. Minimum carrier is 20 gpa for ground or 5 gpa for air. Add NIS at 0.25% v/v. Do not apply within 30 days of harvest (hay) or feeding of forage or grazing. Do not exceed 1.5 lb. ai per application or per year. Do not apply to seedling alfalfa, alfalfa–grass mixtures, or other mixed stands as injury may result

to seedling alfalfa or companion crop. May be tank mixed with other labeled herbicides and adjuvants. Follow label guidelines that are most restrictive.

DORMANT SEASON: Make a single application after alfalfa becomes dormant or during the winter months when alfalfa plants are in the least active stage. Do not apply to snow covered or frozen ground. Late fall application has also been successful in SDSU tests.

SPRING: Apply to dormant alfalfa in spring before new growth exceeds 2 inches in height. Rainfall required.

PARAQUAT PRODUCTS *(paraquat)* Site of Action: 22 **Restricted Use Pesticide**

2 – 3 pt Gramoxone SL 2.0 (0.5 – 0.75 lb. ai) **($7.40–15.45)**
1.3 – 2 pt Devour, Gramoxone SL 3.0, Helmquat, Paraquat, Para-Shot, Quik-Quat 3L

Alfalfa only. Used in established stands as a between cutting or dormant season treatment. Non-residual, non-selective.

DORMANT SEASON: Well-established stands. Apply in late fall after crop is dormant or in early spring before one inch of new growth. Stunting expected if treated late. Do not apply if fall regrowth exceeds 6 inches. Controls emerged broadleaf seedlings and downy brome. Suppression of perennial grass such as bluegrass. Some potential for late fall use in situations where early winter annuals have emerged. Add 1 to 2 pt NIS per 100 gal of solution. Minimum carrier is 10 gpa for ground or 5 gpa for air. Do not use within 42 days of harvest.

1 pt Gramoxone SL 2.0 (0.25 lb. ai) **($4.00–5.40)**
0.7 pt Devour, Gramoxone SL 3.0, Helmquat, Paraquat, Para–Shot, Quik–Quat 3L

BETWEEN CUTTING: Established stands. Controls emerged annual weeds and suppresses perennial grass. Must be applied within 5 days of cutting. Some potential to control annual seedlings emerged at time of first cutting. Do not harvest for 30 days after application. Add 1 to 2 pt NIS per 100 gal of solution. Minimum carrier is 10 gpa for ground.

AIM, ANTIK or LONGBOW *(carfentrazone)* Site of Action: 14 **($3.90–29.55)**

0.5 – 3.8 oz Aim, Antik, or Longbow EC 2L (0.008 – 0.06 lb. ai)

Alfalfa and Clover. Use in established stands. Controls kochia, lambsquarters, pennycress, tansy mustard, and Russian thistle. Use for in between cutting and as a harvest aid for seed production. Do not cut forages for 21 days. Do not harvest seed for three days. Maximum cumulative rate is 2.5 oz for post treatments or 3.8 oz for harvest aid.

DORMANT SEASON: Apply 0.5 – 2.5 oz/A in the fall to dormant alfalfa. May be tank-mixed with other herbicides or insecticides.

BETWEEN CUTTING: May be applied at 0.5 – 2.5 oz per acre. Spray after cutting alfalfa to actively growing weeds. Can spray up to 6 inches of new growth but may have speckling on new growth. Add NIS at 0.25% v/v or COC at 0.5 – 1% v/v. Minimum carrier is 10 gpa for ground and 3 gpa for air.

PREHARVEST: For seed production. Apply 2 – 3.8 oz to actively growing weeds. Add NIS at 0.25% v/v or COC or MSO at 1 – 2% and UAN at 2 – 4% v/v or AMS at 2 – 4 lb./A. Minimum carrier is 10 gpa for ground or 5 gpa for air.

DIURON PRODUCTS *(diuron)* Site of Action: 5 **($8.00–21.45)**

1.5 – 3.0 lb. Karmex, Diuron 80 DF (1.2 – 2.4 lb. ai)
1.2 – 2.4 qt Diuron 4L (1.2–2.4 lb. ai)

DORMANT SEASON: Apply in early spring (March or early April) before spring growth begins. Treat only stands established for at least one year. Do not apply to seedling alfalfa nor to alfalfa/grass mixtures. Do not apply to alfalfa under stress from disease, insect damage, shallow root penetration (such as on shallow hard pans), alkali spots, nor to flooded fields as crop injury may result. Do not spray on snow-covered or frozen ground. Apply only once per year. Do not exceed 2.4 lbs. per acre per year.

KERB *(pronamide)* Site of Action: 3 **($50.50–202.10)**

1.25 – 5 pt Kerb 3 3L
1 – 4 lb. Kerb 50 DF (0.5 – 2 lb. ai)

DORMANT SEASON: Apply late fall to early spring to dormant alfalfa, clover, birdsfoot trefoil, and sainfoin. Apply only after the crop is beyond the first trifoliate stage of fall seeded or after one-year growth on spring seeded. Apply with a minimum carrier of 20 gpa. Do not graze or harvest alfalfa for 25 days after a rate of 1.5 lb. ai or 45 days at 1.5 – 2 lb. ai. Do not graze or harvest other crops for 120 days after application.

FLUMIOXAZIN PRODUCTS *(flumioxazin)* Site of Action: 14 **($4.65–20.20)**

1.5 – 4 oz Chateau SW, Flumi SX, Flumi 51, Tuscany, Varsity, Valkos 51WDG (0.048 – 0.128 lb. ai)
1.5 – 4 oz Chateau EZ, Tuscany, Valkos SC 4L (0.047 – 0.125 lb. ai)

FALL or SPRING: Apply late fall to early spring before alfalfa growth has 6 inches new growth. Rate depends on weed species. Do not apply within 25 days of harvest or grazing. Will not control established weeds. Separate sequential applications by at least 60 days. Do not apply more than 8 oz/A per season. Apply soon after cutting and removing alfalfa to minimize alfalfa injury.

SHARPEN *(saflufenacil)* Site of Action: 14 **($8.25–16.45)**

1 – 2 oz Sharpen 2.85L (0.022 – 0.044 lb. ai)

Provides control of annual broadleaf weeds and suppression of perennial broadleaf weeds. Verify varietal dormancy rating and the selectivity of Sharpen on your alfalfa variety. Sharpen may cause transient injury to alfalfa under certain conditions.

Do not apply to alfalfa grown for seed production. Apply at least 90 days before harvest or yield reductions of the first cutting may occur. Apply with a minimum of 10 gpa. Do not graze or harvest for 28 days after application. For burndown activity, add MSO at 1% v/v and AMS at 8.5 to 17 lb./100 gal or UAN at 1.25 – 2.5% v/v. Allow 14 days between sequential applications. Do not exceed 2 oz/A per season.

DORMANT SEASON Apply late fall to early spring to dormant alfalfa. Apply only to established stands which have gone through a first cutting/mowing.

PENDIMETHALIN PRODUCTS *(pendimethalin)* Site of Action: 3 **($14.40–63.45)**

1.1 – 4.2 qt Prowl H2O, AquaPen or Satellite HydroCap 3.8L (1 – 4 lb. ai)
1.1 – 4.5 qt Satellite Flex 3.5L (1 - 4 lb. ai)
1.2 – 4.8 qt Stealth, Acumen, Framework, Pavilion or Pin–Dee 3.3L (1 – 4 lb. ai)

Established alfalfa. Apply to established alfalfa grown for hay which has gone through a first cutting. Apply as single application or sequential applications at a rate of 1 to 4 lb. ai. Apply prior to weed emergence and before alfalfa is 6 inches tall. Applications can be made in the fall after the last cutting, during winter dormancy, in the spring, or between cuttings.

Acumen and Framework not labeled for established forage alfalfa.

Seed production. (Excluding Prowl H2O, AquaPen) Apply to established alfalfa grown for seed production that has gone through a summer season of cutting. Apply 1 to 4 lb. ai prior to weed emergence as a dormant application, or before alfalfa exceeds 10 inches in height after first cutting, or if the alfalfa has been mowed 2 or more times. Must be applied with drop nozzles directing spray so there is little or no contact with foliage.

Seed production. (Prowl H2O and AquaPen) Apply to established alfalfa grown for seed which has gone through a first cutting. Apply as single application or sequential applications at a rate of 1 to 4 lb. ai. Apply prior to weed emergence and before alfalfa is 6 inches tall. Applications can be made in the fall after the last cutting, during winter dormancy, in the spring, or between cuttings.

Restrictions and Limitations. Do not exceed 4 lb. ai of pendimethalin per acre in a single application. For multiple applications, do not exceed a cumulative total of 4 lb. ai of pendimethalin per acre in any one-crop season. Do not harvest alfalfa forage or hay less than 14 days for Prowl H20 or AquaPen. Do not harvest alfalfa forage or hay less than 50 days for 3.3L. Do not harvest alfalfa forage or hay less than 28 days after applying Satellite Flex or Hydrocap at 2 lb. ai or less of pendimethalin or less than 50 days after applying more than 2 lb. ai of pendimethalin. Do not utilize the 28-day preharvest interval for alfalfa hay more than once per cropping season. Do not apply pendimethalin less than 90 days prior to alfalfa harvest for seed. Some stunting and chlorosis of the alfalfa may occur with postemergence applications. Applications made after the alfalfa exceeds 6 inches in height may result in poor weed control because of possible reduced spray coverage to the soil.

TRIPZIN ZC *(pendimethalin* + *metribuzin)* Site of Action: 3 + 5 **($16.55–50.20)**

29 – 88 oz Tripzin ZC 4L (0.66 – 1.99 + 0.25 – 0.76 lb. ai)

Premix containing 2.9 lb. pendimethalin and 1.1 lb. metribuzin per gallon. Excellent control of most annual grasses and small seeded broadleaf weeds. For optimum weed control, apply to weeds that are less than 2 inches tall or less than 2 inches in diameter. Minimum carrier is 10 gpa for ground or 2 gpa for air.

Do not apply more than 116 oz/A per season. Do not graze or harvest forage or hay for 28 days (58 oz/A or less) or 50 days (more than 58 oz/A). The 28-day preharvest interval for alfalfa hay may only be used once per season. Crop injury may occur when crop is under stress such as disease, insect infestations, drought, poorly drained soils or winter injury or if crop is treated within 12 months after seeding. Crop injury may occur if there is excessive irrigation or rainfall immediately after application. Do not apply more than ½ inch of water in the first irrigation after application. Do not apply less than 90 days before alfalfa harvest for seed.

Established alfalfa or seed production. Apply to established alfalfa grown for forage, hay (which has gone through a first cutting) or seed. Apply as single application or sequential applications. Apply prior to weed emergence and before alfalfa is 6 inches tall. Applications can be made in the fall after the last cutting, during winter dormancy, or in the spring.

GLYPHOSATE PRODUCTS *(glyphosate)* Site of Action: 9 **($1.95–19.90)**

8 – 64 oz Glyphosate 3L ae (0.19 – 1.5 lb. ae)
6 – 44 oz Glyphosate 4.5L ae (0.2 – 1.5 lb. ae)

Glyphosate is available in several formulations and is marketed as several brands. Application rates are based on acid equivalent per acre. Refer to the table on page 14 to determine the amount of product required for the rate of acid equivalent required. Refer to each application timing for specific rates.

SPOT TREATMENT: Forage legumes. Used only as a spot treatment in emerged legumes. Primarily for perennial weeds. Rates are 1 to 2 qt for quackgrass, 2 to 3 qt for Canada thistle and 4 qt of 3L ae/A for field bindweed. Remove livestock

before application. Allow 3 days after treatment before grazing or harvesting.

PREHARVEST: Alfalfa. Apply up to 64 oz 3L ae or up to 44 oz 4.5L ae. Intended for use in declining stands where crop destruction is required prior to planting. May be applied at any time during the season. Treated crop and weeds can be harvested and fed to livestock using a 36-hour application to harvest interval. Maximum rates vary with product formulation. Control of perennial grass and alfalfa will be best if there are several inches of new active growth; follow up control may be required for alfalfa or perennial weed regrowth; especially from early spring application.

DORMANT SEASON: Apply 8 – 12 oz/A 3L ae or 6 – 8 oz/A 4.5L ae in spring to dormant alfalfa. Glyphosate should not be applied after alfalfa has broken dormancy and initiated trifoliate leaf expansion. Do not use additional surfactant. Allow 45 days after application before harvesting. Check label for local recommendations.

DODDER CONTROL IN ALFALFA

Alfalfa dodder is an annual parasitic plant and must have a host plant to survive. Dodder does not have any leaves or any chlorophyll to produce carbohydrates. Dodder attaches to the host plant after emergence and extracts the carbohydrates from the host plant. Dodder infestations reduce alfalfa yield and can weaken or kill alfalfa stands.

Suppression

Pursuit (imazethapyr). Apply 6 oz/A after dodder has emerged but prior to or soon after attachment. **($24.20)**

Raptor (imazamox). Apply 4 to 6 oz/A after dodder has emerged but prior to or soon after attachment. **($14.30–28.10)**

Control

Glyphosate. For use in Roundup-tolerant alfalfa. Apply 32 to 64 oz/A 3 lb. ae product.. **($8.15–16.30)**

Herbicides for Legume Establishment without Companion Crop

Seeding without a companion crop and using an herbicide to control weeds is an option if the small grain crop, weeds, or limited rain make it difficult to establish a new seeding. Two cuttings of the seeding year are possible with irrigation.

Manage perennials before seeding: Alfalfa works well to suppress perennial weeds, such as Canada thistle, through competition. However, the weeds should be treated with tillage or herbicides such as glyphosate in the fall before seeding. Perennial grasses should be eliminated prior to establishment.

Annual grasses are very competitive: Grasses can reduce the stand, especially in dry seasons. Use herbicides.

Clip or treat for annual broadleaves: Annual broadleaves can also be competitive, especially in dry seasons. Kochia, wild buckwheat, Russian thistle, or sunflower are common and can be controlled with herbicides. Mowing is effective for light or moderate infestations, especially if they are several inches tall.

Inter-seeded oats: Low rates of oat seeded at the time alfalfa is planted will compete with early season weeds and provide early cover to reduce negative effects of rain or high wind. Oat should be eliminated at early stages with postemergence herbicides. This system has been good in field tests to avoid erosion.

No-till alfalfa seeding: No-till seeding has been very successful. Weed competition can be reduced dramatically in no-till systems if properly planned. Be sure to use a fall burndown herbicide. Apply a spring herbicide to control emerged weeds or volunteer crops at planting. Be certain soil is firmed over the seed. Use postemergence herbicides or mow weeds if necessary.

EPTAM *(EPTC)* Site of Action: 8 **($21.15–38.10)**

2.25 – 4.5 pt Eptam 7L (2 – 4 lb. ai)

Alfalfa, birdsfoot trefoil, and clovers. Do not use on white clover. Do not use if grass is seeded with legume. Gives excellent control of several annual grasses and fair control of certain annual broadleaves. Foxtail control is consistent. Fair on wild oats, weak on kochia, Russian thistle, and smartweed. Established perennials are not controlled.

Crop tolerance is fair to good. Temporary stunting and sealing of the first leaves are frequently noted. Does not cause stand reduction.

Rates vary according to soil type. Rate of 3.5 pt/A has been satisfactory in most SDSU tests. The 2.25 pt/A rate is for annual grass control on lighter, low organic matter soils. No soil pH limitations.

Minimum carrier is 10 gpa for ground equipment. May be applied with liquid fertilizer carrier.

PREPLANT INCORPORATED: Apply before planting to a smooth, dry seedbed and incorporate immediately with a tandem disk set to cut 4 to 6 inches deep or a field cultivator equipped with sweeps. A second incorporation insures thorough mixing, especially under wet, lumpy, or trashy conditions. Follow with a harrow or mulcher to smooth and firm seedbed.

TRUST or TREFLAN HFP *(trifluralin)* Site of Action: 3 **($4.10–13.05)**

1 – 1.5 pt Trust or Treflan HFP 4L (0.5 – 0.75 lb. ai)
5 – 7.5 lb. Treflan TR–10 10G (0.5 – 0.75 lb. ai)

Alfalfa labeling includes use in alfalfa establishment for forage use in the seeding year. Not all trifluralin labels include stand establishment. Trust or Treflan provide very good to excellent control of annual grasses and control some small-seeded annual broadleaves. Crop tolerance is adequate; some early stunting may occur in prolonged cold, wet conditions. The lower rate is for coarse, sandy soil. Not for grass/legume mixtures.

PENDIMETHALIN PRODUCTS *(pendimethalin)* Site of Action: 3 **($7.55–17.00)**

1.1 – 2.1 pt Prowl H20, AquaPen or Satellite HydroCap 3.8L (0.5 – 1 lb. ai)
1.1 – 2.2 pt Satellite Flex 3.5L (0.5 – 1 lb. ai)
1.2 – 2.4 pt Stealth, Pavilion or Pin-Dee 3.3L (0.5 – 1 lb. ai)

Provides very good control of several annual grasses. Higher rates are for heavy, clay soil. Crop tolerance has been adequate in SDSU tests. Minimum carrier is 10 gpa for ground or 5 gpa for air.

PREPLANT INCORPORATED OR PREEMERGENCE: Apply Stealth, Pavilion or Pin-Dee (1.2 – 1.8 pt), Satellite Flex (1.1 – 1.7 pt), or AquaPen or Satellite HydroCap (1 – 1.5 pt) in direct seeded alfalfa. Prowl H2O is not labeled for PPI or PRE. Incorporate 2–3 inches prior to planting or apply after drill seeding alfalfa into a firm seedbed. May cause stand reduction and stunting.

POSTEMERGENCE: Apply 1.1 – 2.1 pt 3.8L, 1.1 – 2.2 pt 3.5L or 1.2 – 2.4 pt 3.3L to seedling alfalfa (planted in fall or spring but NOT gone through a cutting) grown for hay. Apply prior to weed germination. Seedling alfalfa applications can be made when the alfalfa has reached the second trifoliate stage of growth and prior to the alfalfa reaching 6 inches of growth.

Restrictions and Limitations. Do not exceed 4 lb. ai of pendimethalin per acre in a single application. For multiple applications, do not exceed a cumulative total of 4 lb. ai of pendimethalin per acre in any one-crop season. Do not harvest alfalfa forage or hay less than 14 days for Prowl H20 or AquaPen. Do not harvest alfalfa forage or hay less than 50 days

for 3.3L. Do not harvest alfalfa forage or hay less than 28 days after applying Satellite Flex or Hydrocap at 2 lb. ai or less of pendimethalin or less than 50 days after applying more than 2 lb. ai of pendimethalin. Do not utilize the 28-day preharvest interval for alfalfa hay more than once per cropping season. Some stunting and chlorosis of the alfalfa may occur with postemergence applications. Applications made after the alfalfa exceeds 6 inches in height may result in poor weed control because of possible reduced spray coverage to the soil.

IMAZETHAPYR PRODUCTS *(imazethapyr)* Site of Action: 2 **($12.10–24.20)**

3 – 6 oz Pursuit, Praxis, Pemix, Imazethapyr, Thunder or Tronido 2L (0.047 – 0.094 lb. ai)

Alfalfa or Clover. Grasses will be damaged. Controls a wide spectrum of annual broadleaves and certain annual grasses. Control of pigweed, Russian thistle, mustard, and nightshade is excellent; it is also consistent on non-ALS-inhibiting herbicide-resistant kochia, cocklebur, sunflower, and green foxtail. Results on lambsquarters, wild oat, and common ragweed are not consistent; it is not effective on Canada thistle and field bindweed.

Crop tolerance has been good in SDSU tests. Soil pH is not a factor and there are no soil texture restrictions. Some stunting is possible if applied before recommended crop stage when early spring conditions are cold and wet.

Rates are 3 – 6 oz/A. Pigweed, Russian thistle, mustard, and nightshade are controlled with the low rates. Several other weeds including foxtail, cocklebur, and sunflower (if susceptible to ALS-inhibiting herbicides) are more consistently controlled with 6 oz/A.

Minimum carrier is 10 gpa; use 20 gpa for high weed pressure or if residue is heavy. Add NIS at 0.25% or 1.25% COC or 1% MSO plus UAN or AMS.

May be tank-mixed with other labeled herbicides. When tank-mixing, follow additive guidelines according to the product label. Follow rotational crop guidelines for succeeding crops. If a stand is lost after application, allow a 4-month interval before planting alfalfa.

POSTEMERGENCE: Apply after alfalfa has 2 fully expanded trifoliate leaves. Weeds should be small for best results. Do not graze or harvest alfalfa for 30 days after application.

BEYOND XTRA, RAPTOR, IMIFLEX, IMAZAMOX, OCTIVIO, or VULTURE *(imazamox)* Site of Action: 2 **($14.30–28.10)**

4 – 6 oz Beyond Xtra, Raptor, ImiFlex, Imazamox, Octivio, or Vulture 1L (0.031 – 0.047 lb. ai)

Alfalfa only. Grasses will be damaged. Raptor controls a wide spectrum of annual broadleaf and certain annual grassy weeds. Weeds should be actively growing and not exceed 3 inches. Rate is based on weed size and species.

Minimum carrier is 10 gpa for ground or 5 gpa for air; use 20 gpa for high weed pressure or for minimum or no-till. Use COC, MSO, HSOC or NIS and 28% N or AMS.

Do not apply more than 6 oz/A per season or make more than one application per season. Do not apply sequential applications of imazethapyr followed by imazamox (or imazamox followed by imazethapyr) within 60 days or increased crop response may occur. Raptor may be tank-mixed with bromoxynil, 2,4-DB, Poast, or Select.

POSTEMERGENCE: Apply Raptor when seedling alfalfa is in the second trifoliate stage or larger and when the majority of weeds are 1 to 3 inches tall. Seedling alfalfa may show a temporary stunting. There are no grazing or harvest restrictions.

POAST *(sethoxydim)* Site of Action: 1 **($16.50–41.50)**

1 – 2.5 pt Poast 1.5L (0.19 – 0.5 lb. ai)

May be used in new pure alfalfa seedings. Grasses or cereal companion crops will be killed or damaged. This herbicide is used to kill interseeded oats planted with alfalfa to suppress grassy weeds and provide cover during initial emergence. There is no residual activity and no control of broadleaved weeds.

Provides very good to excellent control of green and yellow foxtail, seedling volunteer small grain, wild oat and other annual grasses. Partial to fair quackgrass control can be expected. Other perennial grasses may be less sensitive. Weeds must be growing actively. Drought stress reduces effectiveness. Crop tolerance is excellent.

Poast rates include special early application of 0.75 pt for foxtail (1 – 4 in). Rates for other situations are 0.75 pt for interseeded oat (2 – 8 in); 1 pt for wild oat (2 – 4 in); foxtails, barnyardgrass, witchgrass (3 – 8 in) and volunteer corn (6 – 20 in); 1.5 pt for sandbur (1 – 3 in) and volunteer cereals (2 – 4 in) per acre. For quackgrass (6 – 8 in) use 2.5 pt/A and repeat to improve control.

Add COC at 2 pt/A. The addition of 0.5 to 1 gal 28% N or 2.5 lb. AMS per acre improves control of certain grasses such as wild oat and volunteer cereal. Thorough coverage is important. Minimum carrier is 5 gpa for ground or air. Poast may be tank-mixed with 2,4-DB; however, do not use liquid fertilizer or AMS additives in the mix.

POSTEMERGENCE: Apply rates specified for each weed. Do not graze or harvest wet foliage for 7 days or cut for dry hay for 14 days after treatment.

CLETHODIM PRODUCTS *(clethodim)* Site of Action: 1 **($3.15–32.40)**

6 – 16 oz Select, Arrow, Avatar, Cleanse, Clethodim, Dakota, Gatlin, Intensity, Shadow, Trizenta, Vaquero, or Volunteer 2EC (0.09 – 0.25 lb. ai)
9 – 32 oz Select Max, Intensity One, or Tapout 0.97L (0.07 – 0.25 lb. ai)
4 – 10.67 oz Section Three, Shadow 3EC, or Trizenta 3EC 3L (0.09 – 0.25 lb. ai)

Clethodim may be used on new pure seedings of alfalfa, sanfoin or birdsfoot trefoil. Provides control of emerged annual grasses with limited activity on perennial grasses. Clethodim controls volunteer barley or wheat, woolly cupgrass, wild oat, field sandbur, and downy brome at 2 to 6 in; barnyardgrass, green and yellow foxtail, volunteer oat, witchgrass, and fall panicum at 2 to 8 in. It also controls wild proso millet at 2 to 10 in. There is activity on foxtail barley at 2 to 6 in. Crop tolerance is excellent. Consult individual labels for tank mix options.

Lower rates are for small annual grasses. Minimum carrier is 5 gpa ground, 3 gpa air. Add a surfactant and AMS at 2.5 – 4 lb./A. Individual labels vary on surfactant recommendations with most suggesting COC at 1% v/v or 1 qt/A.

POSTEMERGENCE: Apply to actively growing weeds. Crop may be grown for seed, hay, silage, or direct grazing. Do not apply within 15 days of harvest or grazing. Do not rotate to other crops for 30 days.

BUTYRAC 200 or 2,4-DB 200 *(2,4-DB)* Site of Action: 4 **($7.85–34.40)**

2 – 6 pt Butyrac 200 or 2,4-DB 200 2L (0.5 – 1.5 ai)

Alfalfa, birdsfoot trefoil, red or white clover. Do not use on sweet clover.

For early postemergence weed control in new, pure legume seedings. Most useful for broadleaf weed seedlings such as Russian thistle, wild mustard, pennycress, cocklebur, lambsquarters, and pigweed. Higher rates give suppression of Canada thistle or perennial sowthistle.

Best control if weed seedlings are less than 2 inches tall. Use high rate for weeds 2 to 5 inches tall. Use only low rates on red clover. Fair crop tolerance. Some twisting and leaf malformation noted on legume seedings.

Minimum carrier is 10 gpa for ground and 5 gpa for air.

POSTEMERGENCE: Apply when weed seedlings are small and legume seedlings have reached the 1- to 2-trifoliate leaf stage. Do not treat when crop is under stress or if expected high temperature exceeds 90 degrees F. Do not graze treated areas for 60 days after application.

BROMOXYNIL PRODUCTS *(bromoxynil)* Site of Action: 6 **($8.00–13.70)**

1 – 1.5 pt Broclean, Brox, Maestro, or Moxy 2L (0.25 – 0.38 lb. ai)

Alfalfa only. For new seedings of pure alfalfa. Controls emerged annual broadleaves. Suppression of perennial weeds such as Canada thistle. No effect on grasses. Has no residual activity. Contact action.

Bromoxynil provides very good control of wild buckwheat, kochia, sunflower, cocklebur, and several other seedling broadleaves. Weeds should be small and actively growing. Apply before most weeds exceed 2 inches in height (4-leaf stage) and when the alfalfa has at least 4-trifoliate leaves. Minimum carrier is 20 gpa for ground or 5 gpa for air. Do not use surfactant additives.

Use the lower rate for small weeds and the higher rate for larger weeds. Temporary leaf burn on the alfalfa can be noted in some situations. Application during hot, humid weather increases risk of leaf burn. Leaf burning does not affected stands or reduced crop growth in SDSU tests. Labeling includes tank-mix options for improved weed spectrum control and suppression. Refer to label for approved tank-mix partners.

POSTEMERGENCE: Fall or Spring application. Do not apply if expected temperatures will exceed 70- or 80-degrees F (depending on product used) for 3 days after application. Allow 30-day interval between treatment and harvest.

WARRANT *(acetochlor)* Site of Action: 15 **($14.60–23.40)**

1.25 – 2 qt Warrant 3L (0.94 – 1.5 lb. ai)

Supplemental label for alfalfa. Application can be applied in the spring after alfalfa has emerged or no later than fourth trifoliate stage. Wait at least 20 days after application before haying or grazing.

May be tank-mixed with several products for postemergence weed activity. May use up to two sequential applications however do not apply over 4 qt per season.

POST: Apply postemergence, however emerged weeds will not be controlled. Need to add a tank-mix for post activity.

PARAQUAT PRODUCTS ***(paraquat)*** Site of Action: 22 **Restricted Use Pesticide** **($9.65–20.80)**

2.5 – 4 pt Gramoxone SL 2.0 (0.6 – 1 lb. ai)
1.7 – 2.7 pt Devour, Gramoxone SL 3.0, Helmquat, Paraquat, Para–Shot or Quik–Quat 3L

Alfalfa only. Used preplant or preemergence to replace tillage prior to planting. Non-selective, non-residual activity. Controls emerged annual grasses and broadleaves. Good coverage is important.

PREPLANT or PREEMERGENCE: Prior to planting or after planting but before crop emergence. Useful to control emerged weeds and volunteer crop growth prior to no-till planting in standing grain stubble. Minimize soil disturbance during planting. Lower rates are adequate if weeds are small and growing actively. Use lower rate for most situations. Add 1 to 2 pt NIS per 100 gallons. Minimum carrier is 10 gpa for ground or 5 gpa for air.

GLYPHOSATE PRODUCTS ***(glyphosate)*** Site of Action: 9 **($3.90–43.40)**

1 pt – 4 qt Glyphosate 3L ae (0.38 – 3 lb. ae)
0.7 pt – 3 qt Glyphosate 4.5L ae (0.38 – 3.38 lb. ae)

Glyphosate is available in several formulations and is marketed as several brands. Application rates are based on acid equivalent per acre. Refer to the table below to determine the amount of product required for the rate of acid equivalent required.

Formulation	**Amount of Product for lb. ae**			
	0.38 ae	**0.75 ae**	**1.5 ae**	**3 ae**
3 lb. ae (4 lb. ai)	16 oz	32 oz	64 oz	128 oz
4 lb. ae (5 or 5.4 lb. ai)	12 oz	24 oz	48 oz	96 oz
4.5 lb. ae (5.5 lb. ai)	11 oz	22 oz	43 oz	86 oz

Forage legumes. Use products labeled for burndown before seeding. May be used prior to planting or after planting prior to legume emergence. Primarily for eliminating perennials before seeding or to replace tillage prior to planting in reduced or no-till systems. Useful to control emerged weeds and volunteer crop growth prior to no-till planting in standing grain stubble.

Weeds should be actively growing. Volunteer winter grain and annual bromes must be out of winter dormancy. Non-selective. No soil residual activity. Minimum carrier is 3 gpa for air and ground. Add 17 lb. AMS in each 100-gal solution.

PREPLANT or PREEMERGENCE: Rates are for 3 lb. ae (4 lb. active) product. Use 0.75 to 1 pt/A of 3L ae for seedling annual grasses and volunteer cereals. Rates are 1 to 2 qt for quackgrass, 2 to 3 qt for Canada thistle, and 4 qt/A of 3L ae for field bindweed. Adjust rates for other concentrations.

Herbicide Resistant Alfalfa–Roundup Ready Alfalfa

GLYPHOSATE PRODUCTS Site of Action: 9 **($7.80–19.90)**

32 – 64 oz Glyphosate 3L (0.75 – 1.5 lb. ai)
22 – 44 oz Glyphosate 4.5L (0.75 – 1.5 lb. ai)

Roundup-tolerant alfalfa variety is required. Not all glyphosate products are labeled for in-crop use in alfalfa. Check for label approval. Refer to local seed supplier for availability of Roundup-tolerant alfalfa seed. Refer to the table above to determine the amount of product required for the rate of acid equivalent required for other formulations.

Remove livestock prior to application and wait a minimum of 5 days after application before grazing, cutting, and feeding forage or hay. Do not apply more than 64 oz 3L ae or 44 4.5L ae in a single over-the-top application. Allow 7 days between sequential applications.

Stand Establishment: Apply 22 to 44 fl oz/A of 4.5L ae or 32 to 64 fl oz/A of 3L ae to Roundup-tolerant alfalfa. On new seedlings, apply at least 22 oz of 4.5L or 32 oz of 3L before the 4th trifoliate to remove non-Roundup Ready seedlings. Use higher glyphosate rate on larger weeds and perennial grasses.

Established Stands: Apply 22 to 44 fl oz/A of 4.5L ae or 32 to 64 fl oz/A of 3L ae to Roundup-tolerant alfalfa. Make application after the first cutting, apply up to 5 days prior to harvest.

DOG FIGHT or THUNDER MASTER *(imazethapyr + glyphosate)* Site of Action: 2 + 9 **($9.00–18.00)**

2.2 – 4.4 pt Dog Fight or Thunder Master 2.17L (0.046 – 0.093 + 0.4 – 0.8 lb. ai)

Roundup-tolerant alfalfa variety is required. Thunder Master provides the equivalent of 4 oz (Pursuit) at the 3 pt rate. This has been the use rate in most SDSU studies and has provided good weed control. Add NIS at 0.125 v/v and 2.5 lb./A AMS. Minimum carrier is 10 gpa for ground and 5 gpa for air. Do not apply over 3 pts in the last year of the alfalfa stand. Do not feed, graze or harvest alfalfa for 30 days. Do not apply over 4.4 pt/A per year.

SEEDLING: Apply postemergence after the alfalfa has at least two fully expanded trifoliate leaves. Weeds should be in the rosette stage or from 1 – 3 inches tall for best control.

ESTABLISHED STAND: Apply to alfalfa with less than 3 inches growth/regrowth in the fall, in the spring to dormant or semi-dormant (< 3 in. regrowth), or between cuttings. For between cuttings apply after hay removal.

Weed Response to Herbicides

Weed control percentages are a guide. Percentages are estimated based on favorable conditions.
E = Excellent, 90-95%; G = Good, 80-90%; F = Fair, 65-80%; M = Marginal, 40-65%; P = Poor, under 40%, N = None.

Herbicide	Downy brome[1]	Foxtail	Wild oat	Barnyardgrass	Kochia	Wild mustard	Pennycress	Blue mustard	Lambsquarters	Pigweed	Dandelion	Seedling Dandelion	Canada thistle	Quackgrass
Bromoxynil	N	N	N	N	E	G+	G+	E	G	F	P	M	M	N
Butyrac 200	N	N	N	N	M	E	G+	G	G+	G	P	G	F	N
Clethodim	G	E	E	E	N	N	N	N	N	N	N	N	N	M
Diuron	F	G	F	E	E	E	G	-	G	G	P	P	P	P
Eptam	E	E	G+	G+	F	P	P	P	G	G	P	P	P	M
Gramoxone	F	G	F	F	M	G+	M	M	G	G	M	G	M	F
Kerb	G	F	G	G	F	P	P	-	F	P	P	P	P	F
Metribuzin	G+	F	P	M	G+	E	E	G+	G+	G	F	G	P	P
Poast	F	E	E	G+	N	N	N	N	N	N	N	N	N	G
Pursuit	P	G	P	M	G+[2]	E	E	E	M	G+	G	G	P	P
Beyond Xtra/Raptor	F	G+	P	F	G+[2]	E	E	E	F	G+	M	F	P	P
Sinbar	G+	G	F	F	G+	E	E	G+	G+	G+	M	F	P	P
Treflan	E	G	M	G	F	P	P	P	G	G	P	P	P	P
Velpar	E	G	F	G	G+	E	E	E	G	G	G	E	P	G

[1] Downy brome is commonly referred to as “cheatgrass”
[2] Most kochia populations in South Dakota are resistant to Pursuit and Raptor.

Foliar Insecticides for Alfalfa

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Adam J. Varenhorst, Associate Professor and SDSU Extension Field Crop Entomologist

South Dakota is home to several insects that can reduce the forage quality and seed yield of alfalfa. The insects that are considered major pests include alfalfa weevils, pea aphids, army cutworms, and potato leafhoppers. These insects are commonly observed in alfalfa where they often cause economic losses if left unmanaged. For seed production, Lygus bugs and alfalfa plant bugs can be economically important pests when they feed on the developing buds and cause them to drop from the plant. Other insects that are typically minor pests of alfalfa include several additional aphid species, grasshoppers, and caterpillars. These species can potentially impact yields if their populations increase within a growing season, but they are not as common as the major pests. When determining if insecticide management is necessary, always scout the alfalfa fields and follow recommendations provided by South Dakota State University.

Although blister beetles typically do not cause direct yield loss through feeding, their presence in alfalfa is problematic. This is because blister beetles produce a chemical called cantharidin that causes health issues or death in livestock that consume contaminated hay. Blister beetle populations are typically observed in second and later alfalfa cuttings. Although insecticides are labeled for blister beetle management, we do not recommend spraying for blister beetles as they will remain on the plants after death. Cantharidin remains active even after the death of the beetle so dead beetles on the plants still pose a risk. Management of blister beetles includes cutting alfalfa prior to peak bloom, avoiding hay crimping to reduce the chance of crushing the beetles, and allowing cut hay to dry fully before raking or baling. Most blister beetles will leave a fresh windrow within 3–6 hours after cutting.

A major concern regarding the routine use of insecticides is the development of insecticide resistance in the targeted insect populations. To reduce the probability of developing resistance, it is important to rotate active ingredients and include insecticides with different modes of action in a management plan. This can be achieved by using multiple insecticides with different modes of action or using a single insecticide that has two active ingredients that vary in their mode of action. In addition to rotating insecticides, rotating crops periodically to a non-host for the targeted insect populations is recommended. This can provide effective management of insect pests without the application of insecticides. It is important to always scout fields prior to and after an insecticide application to determine if pest populations responded to the insecticide.

The insecticides presented in this chapter are restricted use, which means that applicators must have a valid South Dakota commercial and/or private applicator license to purchase and apply these products. Follow insecticide label directions carefully and always wear the proper personal protective equipment when working with insecticides to reduce personal exposure.

Remember, the label is law and any deviations from it are considered unlawful. Do not apply insecticides for insects that are not presented on the label. In addition, for any labels with the bee symbol and even those without, try to apply insecticides when pollinators are not actively foraging or when plants are not blooming.

When choosing an insecticide, refer to labels for precise rates based on observed pest insects. Always follow the labeled recommended rates for a crop and insect pest and never go under or over the recommended rates listed on a label.

The products in this chapter are presented as follows:

Mode of action group number (insecticide class)
Active ingredient(s):
Trade Name(s):

Additional resources regarding insecticide safety include:

- IRAC Insecticide Resistance Action Committee (http://www.irac-online.org/modes-of-action/)
- EPA United States Environmental Protection Agency (https://www.epa.gov/pesticide-worker-safety)
- South Dakota Department of Agriculture and Natural Resources (https://danr.sd.gov/Agriculture/default.aspx)
- Kelley Solutions (https://www.kellysolutions.com/SD/searchbychem.asp)

Checklist of insects managed by each foliar insecticide.

Mode of Action Group Number(s)	Active Ingredient(s)	Alfalfa Weevil	Pea Aphid	Potato Leafhopper	Army Cutworm	Lygus Bug/Alfalfa Plant Bug	Blue alfalfa aphid	Spotted alfalfa aphid	Fall armyworm	Beet armyworm	Alfalfa caterpillar	Variegated cutworm	Stink bug	Blister beetle	Grasshopper	Two spotted spider mites
1A	**Carbaryl**	+	-	+	+	+	-	-	+	+	+	+	+	+	-	-
1A	**Methomyl**	+	+	-	-	+	+	+	+	+	+	+	-	-	-	-
1B	**Chlorpyrifos**	+	+	+	+	-	+	+	+	+	+	+	-	-	+	-
1B	**Dimethoate**	+	+	+	-	+	+	+	-	-	-	-	-	-	+	-
1B	**Malathion**	+	+	+	-	+	-	+	+	+	-	-	-	-	+	+
1B	**Phosmet**	+	+	+	-	+	-	-	-	-	-	-	-	-	+	-
3A	**Alpha-cypermethrin**	+	+	+	+	+	+	+	+	+	+	+	+	-	+	-
3A	**Beta-cyfluthrin**	+	+	+	+	+	+	-	+	+	+	+	+	-	+	-
3A	**Bifenthrin**	+	+	-	-	+	+	+	-	-	-	-	-	-	-	+
3A	**Cyfluthrin**	+	+	+	+	+	+	+	+	+	+	+	+	-	+	-
3A	**Gamma-cyhalothrin**	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+
3A	**Lambda-cyhalothrin**	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+
3A	**Permethrin**	+	+	+	+	+	+	+	+	+	+	+	+	-	-	-
3A	**Zeta-cypermethrin**	+	+	+	+	+	+	+	+	+	+	+	+	-	+	-
3A + 1B	**Lambda-cyhalothrin + Chlorpyrifos**	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+
3A + 28	**Lambda-cyhalothrin + Chlorantraniliprole**	+	+	+	+	+	+	+	+	+	+	+	+	+	+	-
4C	**Sulfoxaflor**	-	+	-	-	+	+	+	-	-	-	-	-	-	-	-
4D	**Flupyradifurone**	-	+	+	-	+	+	+	-	-	-	-	-	-	-	-
5	**Spinosad**	+	+	+	+	+	+	+	+	+	+	+	+	-	+	-
10A	**Hexythiazox**	-	-	-	-	-	-	-	-	-	-	-	-	-	-	+
18	**Methoxyfenozide**	-	-	-	-	-	-	-	+	+	+	-	-	-	-	-
22	**Indoxacarb**	+	-	+	-	+	-	-	-	-	+	-	-	-	+	-
28	**Chlorantraniliprole**	-	-	-	-	-	-	-	-	+	+	-	-	-	+	-

"+" = labeled for management in alfalfa
"-" = not labeled for management in alfalfa

Insecticide Modes of Action

Mode of Action Group Number	Insecticide Class
1A	Carbamates
1B	Organophosphates
3A	Pyrethroids, pyrethrins
4C	Sulfoximines
4D	Butenolides
5	Spinosyns
10A	Hexythiazox
18	Diacylhydrazines
22	Oxadiazines
28	Diamides

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Mode of Action 1A (Carbamates)

Active Ingredient: Carbaryl

Trade Names: Carbaryl 4L, Drexel Carbaryl 4L, Sevin XLR Plus

REI: 12 hours **PHI:** 7 days

Targeted Insects: Alfalfa caterpillars, army cutworm caterpillars, variegated cutworm caterpillars, fall armyworm caterpillars, beet armyworm caterpillars, lygus bug nymphs and adults, potato leafhopper nymphs and adults, stink bug nymphs and adults, alfalfa weevil larvae, and blister beetle adults.

The active ingredient carbaryl may cause temporary bleaching of tender alfalfa foliage.

Restrictions: Do not apply more than 1.5 qt/A or 1.5 lb. ai/A in a single season. Do not apply more than once per cutting. Do not apply to target crop during bloom. On dense growth, use 25 – 40 gallons of water per acre with ground equipment to ensure adequate overage.

Active Ingredient: Methomyl

Trade Names: Lannate LV, Lannate SP, Lanveer LV, Nudrin LV, Nudrin SP

REI: 48 hours **PHI:** 7 days

Targeted Insects: Alfalfa caterpillars, variegated cutworm caterpillars, fall armyworm caterpillars, beet armyworm caterpillars, blue alfalfa aphid nymphs and adults, pea aphid nymphs and adults, spotted alfalfa aphid nymphs and adults, lygus bug nymphs and adults, alfalfa weevil larvae.

Restrictions: Do not apply to dormant or semi-dormant alfalfa when the daily temperature is 50 degrees F or lower. Do not apply more than 4 lb. ai/A in a single season. Do not make more than 10 applications per crop.

Mode of Action 1B (Organophosphates)

Active Ingredient: Chlorpyrifos

Trade Names: Chlorpyrifos 4E, Chlorpyrifos 4E AG, Eraser, Pilot 4E, Vulcan, Warhawk, Warhawk Clearform

REI: 24 hours **PHI:** 7-28 days depending on rate and whether for forage/hay or grain/straw

Targeted Insects: Alfalfa caterpillars, army cutworm caterpillars, variegated cutworm caterpillars, fall armyworm caterpillars, beet armyworm caterpillars, blue alfalfa aphid nymphs and adults, pea aphid nymphs and adults, spotted alfalfa aphid nymphs and adults, tarnished bug nymphs and adults, grasshopper nymphs and adults, potato leafhopper nymphs and adults, and alfalfa weevil larvae.

Restrictions: Do not cut or graze within 7 days after application of 0.5 pt/A, 14 days after application of 1.0 pt/A, or 21 days after the application of more than 1 pt/A. Do not apply more than 2 pt in a single application. Do not apply more than 8 pt or more than 2 applications in a single season.

Active Ingredient: Dimethoate

Trade Names: Dimate 4E, Dimethoate 400, Dimethoate 400 EC, Drexel Dimethoate 4EC

REI: 48 hours **PHI:**10 days

Targeted Insects: Blue alfalfa aphid nymphs and adults, pea aphid nymphs and adults, spotted alfalfa aphid nymphs and adults, tarnished plant bug nymphs and adults, potato leafhopper nymphs and adults, alfalfa weevil larvae, and grasshopper nymphs and adults

Restrictions: Do not apply more than once per cutting. Do not apply more than 0.5 lb. ai/A per application or per cutting. Do not apply more than 1.5 lb. ai/A in a single season. Do not reapply within 30 days. Do not apply when bees are actively foraging.

Active Ingredient: Malathion

Trade Names: Drexel Malathion 5EC, Fyfanon 57% EC, Fyfanon ULV-AG, Malathion 5, Malathion 57 EC, Martin's Malathion 57%, Malathion 8 Aquamul, Malathion ULV

REI: 12 hours **PHI:**0 days

Targeted Insects: Fall armyworm caterpillars, beet armyworm caterpillars, grasshopper nymphs and adults pea aphid nymphs and adults, spotted alfalfa aphid nymphs and adults, potato leaf hopper nymphs and adults, lygus bug nymphs and adults, alfalfa weevil larvae, and twospotted spider mite nymphs and adults.

Restrictions: Do not apply more than 1.25 lb. ai/A per cutting. Do not apply more than 2.5 lb. ai/A in a single season. Do not retreat within 7 days.

Active Ingredient: Phosmet

Trade Name: Imidan 70-W

REI: 5 days **PHI:** 7 days

Targeted Insects: Pea aphid nymphs and adults, lygus bug nymphs and adults, grasshopper nymphs and adults, potato leafhopper nymphs and adults, and alfalfa weevil larvae.

Restrictions: Do not apply more than once per cutting. Do not apply to alfalfa during bloom.

Mode of Action 3A (Pyrethroids)

Active Ingredient: Alpha-cypermethrin

Trade Name: Fastac CS

REI: 12 hours **PHI:** 3 days for forage or hay, 7 days for seed

Targeted Insects: Alfalfa caterpillars, army cutworm caterpillars, variegated cutworm caterpillars, fall armyworm caterpillars, beet armyworm caterpillars, blue alfalfa aphid nymphs and adults, pea aphid nymphs and adults, spotted alfalfa aphid nymphs and adults, grasshopper nymphs and adults, tarnished bug nymphs and adults, potato leafhopper nymphs and adults, stink bug nymphs and adults, and alfalfa weevil larvae.

Restrictions: Do not apply more than 11.4 fl oz/A per season. Do not reapply within 7 days.

Active Ingredient: Beta-cyfluthrin

Trade Names: Baythroid XL, Cryptoid XL, Sultrus

REI: 12 hours **PHI:** 7 days (Baythroid XL, Cryptoid XL)

Targeted Insects: Alfalfa caterpillars, army cutworm caterpillars, variegated cutworm caterpillars, fall armyworm caterpillars, beet armyworm caterpillars, blue alfalfa aphid nymphs and adults, pea aphid nymphs and adults, lygus bug nymphs and adults, potato leaf hopper nymphs and adults, grasshopper nymphs and adults, stink bug nymphs and adults, and alfalfa weevil larvae.

Restrictions: Do not apply more than 0.044 lb. ai/A of Baythroid XL per cutting. Do not apply more than 0.019 lb. ai/A of Sultrus within a 5-day interval. Do not apply more than 0.175 lb. ai/A of Baythroid XL or 0.038 lb. ai/A of Sultrus in a single season. Do not apply to alfalfa grown for seed.

Active Ingredient: Bifenthrin

Trade Names: Sniper, Sniper Helios

REI: 12 hours **PHI:** 30 days

Targeted Insects: Blue alfalfa aphid nymphs and adults, pea aphid nymphs and adults, spotted alfalfa aphid nymphs and adults, lygus bug nymphs and adults, and alfalfa weevil larvae and adults.

Restrictions: Both products are only for alfalfa grown for seed. Apply as a pre-bloom or post-bloom only. Do not apply through irrigation. Do not apply using an ultra low volume application. Do not apply more than 6.4 fl oz per acre per application. Do not make more than 2 applications of bifenthrin products per season.

Active Ingredient: Cyfluthrin

Trade Names: Tombstone, Tombstone Helios

REI: 12 hours **PHI:** 7 days

Targeted Insects: Alfalfa caterpillars, army cutworm caterpillars, variegated cutworm caterpilllars, fall armyworm caterpillars, beet armyworm caterpillars, blue alfalfa aphid nymphs and adults, pea aphid nymphs and adults, spotted alfalfa aphid nymphs and adults, grasshopper nymphs and adults, lygus bug nymphs and adults, potato leaf hopper nymphs and adults, stink bug nymphs and adults, twospotted spider mite nymphs and adults, alfalfa weevil larvae, and blister beetle adults.

Restrictions: Do not apply more than 0.088 lb. ai/A per cutting. Do not apply more than 0.35 lb. ai/A in a single season. Do not reapply within 5 days. Do not apply to alfalfa grown for seed.

Active Ingredient: Gamma-cyhalothrin

Trade Names: Declare, Proaxis

REI: 24 hours **PHI:** 3 days for hay

Targeted Insects: Alfalfa caterpillars, army cutworm caterpillars, variegated cutworm caterpillars, fall armyworm caterpillars, beet armyworm caterpillars, blue alfalfa aphid nymphs and adults, pea aphid nymphs and adults, spotted alfalfa aphid nymphs and adults, grasshopper nymphs and adults, lygus bug nymphs and adults, potato leafhopper nymphs and adults, stink bug nymphs and adults, and alfalfa weevil larvae.

Restrictions: Do not apply more than 0.015 lb. ai/A per cutting. Do not apply more than 0.06 lb. ai/A in a single season. Avoid application when bees are actively foraging.

Active Ingredient: Lambda-cyhalothrin

Trade Names: Cavalry II, Crusader 1EC, Crusader 2ME, Drexel L-C, Grizzly Too, Kendo, Kendo 22.8 CS, Labamba, Lambda Select, Lambda T, Lambda T-2, Lambda-Cy, Lambda-Cy AG, LambdaStar, LambdaStar 1CS, LambdaStar Plus, Lamcap II, Lunge, NuFarm Lambda-Cyhalothrin 1 EC, Omni Brand Lambda 1 EC, Paradigm VC, Province II, Ravage, Ravage II, Roundhouse 1EC, Serpent 1 EC, Silencer, Silencer VXN, Warrior II, Willowood Lambda 1EC

REI: 24 hours **PHI:** 30 days (do not feed to animals), 1 day for forage, 7 days for hay

Targeted Insects: Alfalfa caterpillars, army cutworm caterpillars, variegated cutworm caterpillars, fall armyworm caterpillars, beet armyworm caterpillars, blue alfalfa aphid nymphs and adults, pea aphid nymphs and adults, spotted alfalfa aphid nymphs and adults, grasshopper nymphs and adults, lygus bug nymphs and adults, potato leafhopper nymphs and adults, stink bug nymphs and adults, twospotted spider mite nymphs and adults, alfalfa weevil larvae, and blister beetle adults.

Restrictions: Do not apply more than 0.12 lb. ai/A in a single season. Do not apply more than 0.03 lb. ai/A per cutting. Avoid application when bees are actively foraging.

Active Ingredient: Permethrin

Trade Names: Arctic 3.2 EC, Perm-Up 3.2 EC, Perm-Up 25DF, PermaStar AG, Permethrin

REI: 4 hours **PHI:** 14 days

Targeted Insects: Alfalfa caterpillars, green cloverworm caterpillars, beet armyworm caterpillars, fall armyworm caterpillars, army cutworm caterpillars, variegated cutworm caterpillars, blue alfalfa aphid nymphs and adults, pea aphid nymphs and adults, spotted alfalfa aphid nymphs and adults, potato leafhopper nymphs and adults, lygus bug nymphs and adults, stink bug nymphs and adults, and alfalfa weevil larvae and adults.

Restrictions: Do not apply more than 0.2 lb. ai/A in a single application. Do not apply more than 0.2 lb. ai/A per cutting. The retreatment interval for these insecticides is 30 days. Avoid application when bees are actively foraging.

Active Ingredient: Zeta-cypermethrin

Trade Names: Cortes Maxx, Datsun, Mustang, Mustang Maxx

REI: 12 hours **PHI:** 3 days for forage or hay, 7 days for seed

Targeted Insects: Alfalfa caterpillars, army cutworm caterpillars, variegated cutworm caterpillars, fall armyworm caterpillars, beet cutworm caterpillars, blue alfalfa aphid nymphs and adults, pea aphid nymphs and adults, spotted alfalfa aphid nymphs and adults, grasshopper nymphs and adults, lygus bug nymphs and adults, potato leafhopper nymphs and adults, stink bug nymphs and adults, and alfalfa weevil larvae.

Restrictions: For Mustang, do not apply more than 0.1 lb. ai/A per cutting or more than 0.3 lb. ai/A in a single season. For Cortes Maxx and Mustang Maxx, do not apply more than 0.5 lb. ai/A per cutting or more than 0.15 lb. ai/A in a single season. Do not reapply within 7 days.

Modes of Action 3A (Pyrethroids) + 1B (Organophosphates)

Active Ingredients: Lambda-cyhalothrin + Chlorpyrifos

Trade Name: Drexel Lambdafos

REI: 24 hours **PHI:** 7 days (6 – 13 fl oz/A), 14 days (13 – 26 fl oz/A), 21 days (26+ fl oz/A)

Targeted Insects: Alfalfa caterpillars, army cutworm caterpillars, variegated cutworm caterpillars, fall armyworm caterpillars, beet armyworm caterpillars, blue alfalfa aphid nymphs and adults, pea aphid nymphs and adults, spotted alfalfa aphid nymphs and adults, grasshopper nymphs and adults, lygus bug nymphs and adults, potato leafhopper nymphs and adults, stink bug nymphs and adults, twospotted spider mite nymphs and adults, alfalfa weevil larvae, and blister beetle adults.

Restrictions: Do not apply more than 38 fl oz/A in a single application. Do not apply more than 119 fl oz/A in a year. Do not apply any product containing Chlorpyrifos more than once per cutting. Do not make a second application of this product or other Chlorpyrifos products within 10 days of the first application.

Modes of Action 3A (Pyrethroids) + 28 (Diamides)

Active Ingredients: Lambda-cyhalothrin + Chlorantraniliprole

Trade Name: Besiege

REI: 24 hours **PHI:** 1 day for forage, 7 days for hay

Targeted Insects: Alfalfa caterpillars, army cutworm caterpillars, variegated cutworm caterpillars, fall armyworm caterpillars, beet armyworm caterpillars, blue alfalfa aphid nymphs and adults, pea aphid nymphs and adults, spotted alfalfa aphid nymphs and adults, grasshopper nymphs and adults, lygus bug nymphs and adults, potato leafhopper nymphs and adults, stink bug nymphs and adults, alfalfa weevil larvae, and blister beetle adults.

Restrictions: Do not apply more than 0.12 lb. ai/A of lambda-cyhalothrin or 0.2 lb. ai/A of chlorantraniliprole in a single season. Do not apply more than 10 fl oz/A of Besiege per cutting or more than one application per cutting. Do not apply when bees are actively foraging.

Mode of Action 4C (Sulfoximines)

Active Ingredient: Sulfoxaflor

Trade Name: Transform WG

REI: 24 hours **PHI:** 7 days

Targeted Insects: Aphid species, Lygus bugs

Restrictions: Do not apply more than 8.5 fl oz/A per season. Do not apply more than 2 applications per cutting. Do not reapply within 7 days.

Mode of Action 4D (Butenolides)
Active Ingredient: Flupyradifurone
Trade Names: Sivanto HL, Sivanto 200 SL, Sivanto Prime
REI: 4 hours **PHI:** 7 days

Targeted Insects: Blue alfalfa aphid nymphs and adults, pea aphid nymphs and adults, spotted alfalfa aphid nymphs and adults, lygus bug nymphs and adults, and potato leaf hopper nymphs and adults.

Restrictions: Do not apply more than 0.365 lb. ai/A in a single season. Do not reapply within 10 days.

Mode of Action 5 (Spinosyns)
Active Ingredient: Spinosad
Trade Names: Entrust, Entrust SC
REI: 24 hours **PHI:** 3 days for forage or hay, 21 days for seed

Targeted Insects: Fall armyworm caterpillars, beet armyworm caterpillars and alfalfa weevil larvae and adults.

Restrictions: Do not apply more than 3 times in a single season. Do not apply more than 5.6 fl oz/A of Entrust or 19 fl oz/A of Entrust SC per season. Do not allow livestock to graze from the treated area until the spray has dried.

Mode of Action 10A (Hethythiazox)
Active Ingredient: Hexythiazox
Trade Names: Hexy 1E, Onager Optek, Ruger 1EC
REI: 12 hours **PHI:** 14 days

Targeted Insects: Twospotted spider mites.

Restrictions: Do not make more than 1 application per calendar year. Do not apply more than 24 fl oz/A in a single season.

Mode of Action 18 (Diacylhydrazines)
Active Ingredient: Methoxyfenozide
Trade Names: GCS Methoxy 2F, Inspirato 2F, Intrepid 2F, Invertid 2F, Zylo
REI: 4 hours **PHI:** 7 days

Targeted Insects: Alfalfa caterpillars, fall armyworm caterpillars, and beet armyworm caterpillars.

Restrictions: Do not apply more than 32 fl oz/A or 0.5 lb. ai/A in a single season. Do not make more than one application per cutting.

Mode of Action 22 (Oxadiazines)
Active Ingredient: Indoxacarb
Trade Names: Host EC, Sedaire EC, Steward EC
REI: 12 hours **PHI:** 7 days

Targeted Insects: Alfalfa caterpillars, grasshopper nymphs and adults, lygus bug nymphs and adults (suppression only), potato leafhopper nymphs and adults (suppression only), and alfalfa weevil larvae.

Restrictions: Do not apply more than 11.3 fl oz/A per cutting. Do not apply more than 45 fl oz/A in a single season. Do not reapply within 5 days. Do not apply to alfalfa grown for seed.

Mode of Action 28 (Diamides)
Active Ingredient: Chlorantraniliprole
Trade Names: Coragen, Prevathon, Shenzi 400SC, Vantacor
REI: 4 hours **PHI:** None

Targeted Insects: Alfalfa caterpillars, beet armyworm caterpillars, and grasshopper nymphs and adults.

Restrictions: Do not make more than 1 application per cutting. Do not make more than 4 applications within a season. Do not apply more than 0.2 lb. ai/A in a single calendar year.

Grasshoppers: For best results add Methylated Seed Oil (MSO) adjuvant at 1 gallon/100 gallons of spray volume. Apply when grasshoppers are still nymphs.

Fungicide and Insecticide Seed Treatments in Alfalfa

Madalyn Shires, Assistant Professor and SDSU Extension Plant Pathologist
Connie Strunk, SDSU Extension Plant Pathology Field Specialist
Bradley McManus, SDSU Extension IPM Specialist
Adam J. Varenhorst, Associate Professor and SDSU Extension Field Crop Entomologist
Patrick Wagner, SDSU Extension Entomology Field Specialist
Philip Rozeboom, SDSU Extension IPM Coordinator

Seed treatments are useful tools in promoting stand establishment and seedling vigor. In general, seed treatments are used for three primary reasons:

1. To control soil-borne fungal disease organisms such as those causing seed rots or seedling blights in many crops, as well as the agents of root rot complex, smuts, or downy mildews.
2. To control diseases caused by surface-borne fungal pathogens.
3. To manage diseases caused by seed-borne fungi.

In general, insecticidal seed treatments for alfalfa are used to manage the following early season insect pests (first-second cutting) of newly established alfalfa:

1. Aphids
2. Potato leafhoppers

Seed treatment may not be for every field. When deciding on seed treatments, establish the history of seedling diseases, soil conditions at planting (wet and cool soils, no-till fields, non-rotated fields), insect pest history, if the crop is for grain or seed production, susceptibility of the cultivar to be planted, target plant population etc. to help you decide on the need for seed treatment. Proper identification of disease agent is also important. Agronomy or Plant Pathology Extension Specialists or the Plant Disease Diagnostic Clinic at SDSU can assist producers in identifying plant health problems affecting stand establishment and throughout the growing season. It is important to note that most seed treatment products do not control all types of fungal pathogen issues. Effectiveness of control will vary with seed treatment product, rate, environmental conditions, and pests present.

Integrated Disease Management
Disease management in agricultural crops requires a multi-faceted approach as part of an integrated pest management (IPM) program.

Effective components of an integrated plant disease management program include the following:

- Crop rotation, rotation to non-host crops to reduce pathogen load.
- Residue and volunteer management for reduction of residue-borne and overwintering diseases.
- Use of high quality, disease-free seed to prevent the spread of seed-borne diseases and promote healthy stand establishment.
- Proper variety selection for host resistance and adaptation to the growing region.
- Proper plant health management. Healthy plants are more able to resist or tolerate the development of plant diseases.

Seed treatments containing fungicides combinations may adversely affect microbial inoculants applied to legume seed, such as alfalfa. Applicators should carefully read and follow any label instructions and limitations for both the pesticide seed treatment and the inoculant. Liquid fungicides should not be directly mixed with liquid inoculants prior to application, and care should be taken to limit the time that inoculants and pesticide seed treatments are in direct contact.

Proper Application and Use Precautions
Fungicide and insecticide seed treatment products vary in formulation type, packaging, and use requirements. Products may be dry, liquid, in concentrate, or ready-to-use formulations. While many seed treatments may be applied on-farm, several products are limited to use only by commercial applicators using closed application systems. Use caution when handling or working with seed treatment products. Fungicide and insecticide seed treatments can be highly poisonous, and many are irritants, so proper handling precautions must be taken. Producers and applicators must strictly adhere to all label directions regarding safe handling, mixing, storage, and disposal. Using personal protection, including an approved respirator, goggles, and pesticide resistant gloves, is recommended even if not specifically required by the fungicide label.

Follow label rates, as over-application may result in unintentional damage to the seed, and under-application may reduce the product's effectiveness. Properly calibrate all application equipment to assure uniform coverage. Uniform coverage of the seed is critical to optimize effectiveness of the seed treatment.

The products in this chapter are presented as follows:

Trade name(s) *(Chemical common name)* Mode of action: Group code (chemical class)

Additional resources regarding insecticide safety can be found at:

- IRAC Insecticide Resistance Action Committee (http://www.irac-online.org/modes-of-action/)

- EPA United States Environmental Protection Agency (https://www.epa.gov/pesticide-worker-safety)
- South Dakota Department of Agriculture and Natural Resources (https://danr.sd.gov/Agriculture/default.aspx)
- Kelley Solutions (https://www.kellysolutions.com/SD/searchbychem.asp)

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Fungicides

Insecticides

Fungicide FRAC Codes and Group Names

FRAC Code	Group Name
1	Methyl benzimidazole carbamate (MBC)
3	Demethylation inhibitor (DMI)
4	Phenylamide (PA)
7	Succinate dehydrogenase inhibitor (SDHI)
11	Quinone outside inhibitor (QoI)
12	Phenylpyrroles (PP)
22	Benzamide, thiazole carboxamide
M03	Multi-site

Insecticide Mode of Action

Mode of Action Group Number	Insecticide Class
4A	Neonicotinoids

Check list of diseases managed by each seed treatment pesticide

Product Names	Seed & seedling rots	Pythium/Phytophthora root rots	Downy mildew
Acquire, Allegiance FL, Belmont 2.7 FS, Dyna-Shield Metalaxyl, Dyna-Shield Metalaxyl 318 FS, MetaStar 2E, Sebring 318 FS, Sebring 480 FS	-	+	-
Apron XL	+	+	+
Ultra Flourish, RidomilGold SL	+	+	-
EverGol Energy	+	-	-
Maxim 4FS, Spirato 480 FS, Dyna-Shield Fludioxonil	+	-	-
Maxim XL	+	+	+
Mertect 340-F	+	-	-
Stamina	+	-	-
Trilex Flowable Fungicide	+	-	-

"+" = provides protection
"-" = does not provide protection

Check list of insects managed by each insecticide seed treatment.

Product Name(s)	Aphids	Potato Leafhoppers
Adage, Elliptica, Legend 5L ST, Phalanx	+	+

"+" = product provides control

Fungicide Seed Treatments

Acquire, Allegiance FL, Belmont 2.7 FS, Dyna-Shield Metalaxyl, Dyna-Shield Metalaxyl 318 FS, MetaStar 2E, Sebring 318 FS, Sebring 480 FS *(metalaxyl)* Mode of Action: 4 (PA)

Application rate:
Acquire, Allegiance FL, Belmont 2.7 FS, Dyna-Shield Metalaxyl, Metalaxyl 318 FS, Sebring 318 FS: 0.75 – 1.5 fl oz/cwt
MetaStar 2E: 1–2 pt/A (Spray at planting in a minimum of 20 gals of water)
Sebring 480 FS: 0.50–1.0 fl oz/cwt

REI: 24 hours in all except MetaStar 2E which is 48 hours.

Targeted diseases: Pythium/Phytophthora root rots

Restrictions: Do not feed green forage or cut 60 days after MetaStar 2E application.

Apron XL, Ultra Flourish, Ridomil Gold SL *(mefenoxam)* Mode of Action: 4 (PA)

Application rate:
Apron XL: 0.64 floz/cwt
Ultra Flourish: 0.5 – 1 pt/A
Ridomil Gold SL: 0.25 pt/A

REI: 48 hours

Targeted diseases: Apron XL, Ultra Flourish, Ridomil Gold SL: Seed and seedling rots, and Pythium/Phytophthora root rots. Apron XL: Suppression of early season downy mildew.

Restrictions: Apron XL — Do not apply more than 0.0047 lb. ai/Acre (0.031 lb ai/100 lb seed/year) per calendar year of mefenoxam or metalaxy-containing products as a seed treatment on nongrass animal feeds. Ultra Flourish — do not apply more than 1 pt/A per year; Ridomil Gold SL has a max rate of 0.5 pt/A per year. Do not use seed with Apron XL for feed, food, or oil purposes. Do not feed green forage or cut hay for 60 days following applications of Ultra Flourish or Ridomil Gold SL. Preharvest interval for Ridomil Gold SL is 60 days.

EverGol Energy *(prothioconazole + penflufen + metalaxyl)* Mode of Action: 3, 4, 7 (DMI, PA, SDHI)

Application rate: 3 fl oz/cwt

REI: 24 hours

Targeted diseases: *Rhizoctonia* seed and seedling rots.

Restrictions: Do not exceed 0.00225 lb. penflufen/A per crop season.

Maxim 4FS, Spirato 480 FS, Dyna-Shield Fludioxonil *(fludioxonil)* Mode of Action: 12 (PP)

Application rate: 0.08 – 0.16 fl oz/cwt

REI: 12 hours

Targeted diseases: Seed and seedling rots.

Restrictions: Forage may not be grazed until 30 days after planting.

Maxim XL *(fludioxonil + mefenoxam)* Mode of Action: 4, 12 (PA, PP)

Application rate: 0.167–0.334 fl oz/cwt

REI: 48 hours

Targeted diseases: Seed and seedling rots, Pythium/Phytophthora root rots, and suppression of Downy mildew.

Restrictions: To be used with additional Apron XL (0.553 – 0.598 fl oz/cwt – see label for instructions). If grazing, preharvest interval is 30 days. Do not apply more than 0.25 lb ai/Acre/year of mefenoxam or metalaxyl containing products as a seed treatment of forage legumes.

Mertect 340-F *(thiabendazole)* Mode of Action: 1 (MBC)

Application rate: 5.8 fl oz/cwt

REI: 12 hours

Targeted diseases: Seedling rots caused by *Fusarium* spp.

Restrictions: For protection against other seed and soil-borne diseases, combine with other seed treatment fungicides. Do not apply more than 0.15 lb. thiabendazole per acre (68.0 grams ai/A) per year.

Stamina *(pyraclostrobin)* Mode of Action: 11 (QoI)

Application rate: 1.5 – 3.1 fl oz/cwt

REI: 12 hours

Targeted diseases: Seed and seedling rots caused by *Rhizoctonia solani*. Suppression of seed and seedling disease caused by *Aphanomyces euteiches*, *Fusarium* spp., *Phytophthora medicaginis*.

Restrictions: Higher rates are acceptable when disease pressure is expected to be high.

Trilex Flowable Fungicide *(trifloxystrobin)* Mode of Action: 11 (QoI)

Application rate: 0.96 fl oz/cwt

REI: 12 hours

Targeted diseases: Seed and seedling rots caused by *Alternaria* spp., *Aspergillus* spp., *Cladosporium* spp, *Penicillium* spp, *Rhizoctonia solani*, and *Fusarium* spp.

Insecticide Seed Treatments

Adage, Elliptica, Legend 5L ST, Phalanx *(thiamethoxam)* Mode of Action: 4A (Neonicotinoids)

Application Rate: 0.001 mg ai/seed or 10.24 – 32 fl oz/cwt

REI: 12 hours

Targeted insects: Protects first cutting seedlings from aphids and potato leaf hoppers.

Restrictions: Do not use more than 0.22 lb./A of thiamethoxam per acre per season. Only apply in commercial seed treatment facilities. Do not apply on farm.

Fungicides in Alfalfa

Madalyn Shires, Assistant Professor and SDSU Extension Plant Pathologist
Connie Strunk, SDSU Extension Plant Pathology Field Specialist

In South Dakota and in the region, there are generally fewer fungicides approved for alfalfa partly due to the limited economic returns of their application in alfalfa. Moreover, the registered fungicides on alfalfa are labeled for only a few diseases: rust, white mold, and spring black stem and leaf spot. Rust is rarely a production constraint on alfalfa in South Dakota, while spring black stem and leaf spot, white mold, and stem rot are quite sporadic. Fungicide use on alfalfa should be considered on a field-by-field basis depending on other risk factors including favorable weather conditions, age of the crop, severity of the disease, and the susceptibility of the cultivar planted. Foliar fungicides alone are not the most effective means of managing diseases. Well-adapted, disease-resistant varieties should always be used where possible and can be combined with good cultural practices, such as crop rotation, disease-free seed, residue management, and optimal planting dates. Additionally, good crop scouting methods will help producers make sound decisions about when to apply fungicides as the need arises.

Fungicide Resistance Management

Resistance to fungicides can develop in pathogen populations under certain conditions. When selection pressure is placed on fungi through repeated application of a single product or class of products to the same field, a fungal pathogen population may develop reduced sensitivity to those chemicals. This can happen very quickly if repeated applications are made in a single season. Strobilurin fungicides seem to be especially prone to this effect, while triazoles have somewhat less risk of inducing resistance. To reduce the risk of developing fungicide resistant pathogens, adopt a fungicide resistance management strategy that includes the following practices:

- Apply fungicides only when necessary to prevent or treat fungal disease.
- Apply only at recommended rates.
- Use integrated management to reduce the number of applications necessary.
- Avoid repeated applications of the same product or mode-of-action to a single site.
- Use strobilurins only as preventatives.
- Strobilurins should represent no more than 30–50% of total number of applications to a site.

The following is a list of fungicides labeled for use on alfalfa in South Dakota at the time of this publication. The list is dynamic, not exhaustive, and therefore should not be considered as a substitute for label information. Always read and follow label directions for approved uses of these products and check with the South Dakota Department of Agriculture and Natural Resources for up-to-date product registration information.

The products in this chapter are presented as follows:

Trade name(s) *(Chemical common name)* Mode of action: Group code (chemical class)

Additional resources regarding pesticide safety can be found at:

- IRAC Insecticide Resistance Action Committee (http://www.irac-online.org/modes-of-action/)
- EPA United States Environmental Protection Agency (https://www.epa.gov/pesticide-worker-safety)
- South Dakota Department of Agriculture and Natural Resources (https://danr.sd.gov/Agriculture/default.aspx)
- Kelley Solutions (https://www.kellysolutions.com/SD/searchbychem.asp)

Fungicide FRAC Codes and Group Names

FRAC Code	Group Name
3	Demethylation inhibitor (DMI)
7	Succinate dehydrogenase inhibitor (SDHI)
11	Quinone outside inhibitor (QoI)
BM02	Biological with multiple modes of action

Diseases listed on the product label for alfalfa

Product Name(s)	Rust	Common leaf spot	Spring black stem & leaf spot	Summer black stem & leaf spot	Leptoshaerulina leaf spot	Powdery mildew	White mold	Stemphylium leaf spot	Downy mildew	Rhizoctonia (patch, blight)
AFS009 Strain of Pseudomonas chlororaphis *(Howler)*	+	-	-	-	-	+	+	-	+	+
Azoxystrobin *(Aframe, Azoxy 2SC, Quadris, Satori, Trevo)*	+	+	+	+	-	+	-	+	+	+
Boscalid *(Endura)*	-	+	+	-	-	+	+	-	-	-
Copper Hydroxide *(Kocide 3000-O)*	-	-	-	-	+	-	-	-	-	-
Mefentrifluconazole + Fluxapyroxad + Pyraclostrobin *(Revytek)*	+	+	+	+	+	+	-	+	-	+
Penthiopyrad *(Fontelis)*	-	-	-	-	-	+	+	+	-	-
Pyraclostrobin *(Headline, Headline SC)*	+	+	+	+	-	+	-	+	+	+
Pyraclostrobin + Fluxapyroxad *(Priaxor Xemium)*	+	+	+	+	-	+	-	+	+	+
Pyraclostrobin + Boscalid *(Pristine Fungicide)*	+	+	+	+	-	+	+	+	+	+
QST 713 Strain of Bacillus subtillis *(Serenade MAX)*	-	-	-	-	-	-	+	-	-	-

"+" = provides protection
"-" = does not provide protection

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Aframe, Azoxy 2SC, Quadris, Satori, Trevo *(azoxystrobin)* Mode of Action: 11 (QoI)

Application rate: 6 – 15.5 fl oz/A

REI: 4 hours

Targeted diseases: Common leaf spot *(Pseudopeziza medicaginis)*, Spring black stem and leaf spot *(Phoma medicaginis)*, Summer black stem and leaf spot *(Cercospora medicaginis)*, Rust *(Uromyces spp.)*, Powdery mildew *(Erysiphe pisi)*, Downy mildew *(Perenospora trifoliorum)*, and Rhizoctonia blight/black patch *(Rhizoctonia spp.)*

Restrictions: Apply prior to disease development and continue throughout the season. Use higher rates when disease pressure is severe. Do not apply within 14 days of harvest and grazing. Do not apply more than three sequential applications without alternating with another fungicide chemistry not in Group 11. Do not apply more than 2 applications per year at the high rate of 15.5 fl oz/A. Aframe, Azoxy 2SC, Quadris and Satori may be applied by ground, air or through chemigation. Use of an adjuvant such as a crop oil concentrate (COC) or a non-ionic surfactant (NIS) is recommended. Do not apply more than 42 fl oz/A/year or 0.75 lbs. ai/A/year. Not for use on rangeland.

Endura *(boscalid)* Mode of Action: 7 (SDHI)

Application rate: 6.5 fl oz/A for forage and hay
Application rate: 6 – 11 fl oz/A for alfalfa grown for seed; 8 – 11 fl oz/A for white mold suppression

REI: 12 hours

Targeted diseases: Common leaf spot *(Pseudopeziza medicaginis)* and Spring black stem and leaf spot *(Phoma medicaginis*). For suppression only: Powdery mildew *(Erysiphe pisi)*, and White mold *(Sclerotinia spp)*.

Restrictions: Apply prior to disease development and continue on a 14 – 21-day interval. Use a shorter interval when the disease pressure is high. Do not apply within 14 days of harvest. Do not make more than 2 applications per cutting or make more than 3 applications of Endura per year for alfalfa grown for forage and hay. Do not apply more than 2 applications of Endura per year for alfalfa grown for seed. Do not apply more than 19.5 fl oz/A per year to alfalfa for forage and hay. Do not apply more than 22 fl oz/A per year to alfalfa grown for seed. Endura may be applied by ground, air or through chemigation. No restrictions for livestock grazing or feeding on alfalfa for forage and hay.

Fontelis *(penthiopyrad)* Mode of Action: 7 (SDHI)

Application rate: 14 – 24 fl oz/A for Powdery mildew and Stemphylium leafspot
Application rate: 16 – 24 fl oz/A for White mold

REI: 12 hours

Targeted diseases: Powdery mildew *(Erysiphe pisi)*, White mold *(Sclerotinia spp)*, and Stemphylium leaf spot *(Stemphylium botryosum)*.

Restrictions: Apply prior to disease development and continue on a 7 – 14-day interval. Use the higher rate and shorter intervals when disease pressure is high. Do not apply within 14 days of harvest. Do not apply more than two sequential applications without alternating with another fungicide chemistry. Do not apply more than 48 fl oz/A/year. Frontelis may be applied by ground, air or through chemigation. Apply a minimum of 15 gallons/A by ground or 10 gallons/A by air-assisted ground applicator or 2 gallons/A by air.

Headline, Headline SC *(pyraclostrobin)* Mode of Action: 11(QoI) Stemphyllium leaf spot (*Stemphyllium spp.*)

Application rate: 6 – 9 fl oz/A

REI: 12 hours

Targeted diseases: Common leaf spot *(Pseudopeziza medicaginis)*, Spring black stem and leaf spot *(Phoma medicaginis)*, Summer black stem and leaf spot *(Cercospora medicaginis)*, Rust *(Uromyces spp)*, Powdery mildew *(Erysiphe pisi)*, Downy mildew *(Perenospora trifoliorum)*, Stemphyllium leaf spot (*Stemphyllium spp.*) and Rhizoctonia blight/black patch *(Rhizoctonia spp.)*.

Restrictions: Apply prior to disease development and continue on a 14 – 21-day interval if conditions are favorable for disease. Use the higher rate and shorter intervals when disease pressure is high. Do not apply within 14 days of harvest. Do not make more than 2 applications per cutting or make more than 3 applications of Headline and Headline SC per year. Do not apply more than 27 fl oz/A per year.

Howler *(AFS009 Strain of Pseudomonas chlororaphis)* Mode of Action: BM02

Application rate: 2.5 – 7.5 lb./A

REI: 4 hours

Targeted diseases: Downy mildew *(Perenospora spp.)*, Powdery mildew *(Erysiphe spp.)*, Rhizoctonia blight *(Rhizoctonia spp.)*, Rust *(Puccinia spp.)*, and White mold *(Sclerotinia spp)*.

Restrictions: Begin applications prior to infection and continue every 5 – 14 days as needed. Use higher rate and shorter intervals when disease pressure is high. Use lower rates when used in tank mixes and/or rotations with other effective fungicides. Howler may be applied by ground, air or through chemigation.

Kocide 3000-O *(copper hydroxide)* Mode of Action: Unknown

Application rate: 0.75 lbs./A

REI: 48 hours

Targeted diseases: Cercospora leaf spot *(Cercospora spp.)*, and Leptoshaerulina leaf spot *(Leptoshaerulina briosiana)*

Restrictions: Apply 10 – 14 days before each harvest or earlier if disease threatens. Repeat every 30 days if needed. Maximum seasonal rate: 3.7 lbs./acre. Spray injury may occur with sensitive varieties such as Lahontan. Kocide 3000-0 may be applied by ground, air or through chemigation.

Priaxor Xemium *(pyraclostrobin + fluxapyroxad)* Mode of Action: Strobirulin, 11, 7 (QoI, SDHI)

Application rate: 4 – 6.9 fl oz/A

REI: 12 hours

Targeted diseases: Common leaf spot *(Pseudopeziza medicaginis)*, Spring black stem and leaf spot *(Phoma medicaginis)*, Summer black stem and leaf spot *(Cercospora medicaginis)*, Rust *(Uromyces spp)*, Powdery mildew *(Erysiphe pisi)*, Downy mildew *(Perenospora trifoliorum)*, Stemphylium leaf spot (*Stemphylium spp.*) and Rhizoctonia blight/black patch *(Rhizoctonia spp.)*.

Restrictions: Apply prior to disease development and continue on a 14 – 21-day interval if conditions are favorable for disease. Use the higher rate and shorter intervals when disease pressure is high. Do not apply within 14 days of harvest or grazing. Do not make more than 2 applications of Priaxor per cutting or 3 applications of Priaxor per year. Priaxor Xemium may be applied by ground, air or through chemigation. Do not apply more than 20.7 oz/A per year. Do not use on rangeland.

Pristine Fungicide *(pyraclostrobin + boscalid)* Mode of Action: Strobirulin, 11, 7 (QoI, SDHI)

Application rate: 12 – 18 fl oz/A
White Mold Application rate: 14 – 18 fl oz/A

REI: 12 hours

Targeted diseases: Common leaf sot *(Pseudopeziza medicaginis)*, Spring black stem and leaf spot *(Phoma medicaginis)*, Summer black stem and leaf spot *(Cercospora medicaginis)*, Rust *(Uromyces spp)*, Powdery mildew *(Erysiphe pisi)*, Downy mildew *(Perenospora trifoliorum)*, Stemphylium leaf spot (*Stemphylium spp.*), Rhizoctonia blight/black patch *(Rhizoctonia spp.)*, and white mold *(Sclerotinia spp)*.

Restrictions: Apply prior to disease development and continue on a 14 – 21-day interval if conditions are favorable for disease. Use the higher rate and shorter intervals when disease pressure is high. Do not apply within 14 days of harvest. Do not make more than 2 applications per cutting or make more than 3 applications of Pristine per year. Pristine may be applied by ground, air or through chemigation. Do not apply more than 54 oz/A per year. No livestock feeding restrictions.

Revytek *(mefentrifluconazole + pyraclostrobin + fluxapyroxad)* Mode of Action: 3, 7, 11 (DMI, SDHI, QoI)

Application rate: 8 – 13 fl oz/A

REI: 12 hours

Targeted diseases: Common leaf sot (*Pseudopeziza medicaginis*), Spring black stem and leaf spot (*Phoma medicaginis*), Summer black stem and leaf spot (*Cercospora medicaginis*), Rust (*Uromyces spp*), Powdery mildew (*Erysiphe pisi*), Stemphylium leaf spot (*Stemphylium spp.*), Leptoshaerulina leaf spot (*Leptoshaerulina briosiani*), and Rhizoctonia blight/black patch (*Rhizoctonia spp.*)

Restrictions: Apply prior to disease development and continue on a 14 – 21-day interval if conditions are favorable for disease. Do not apply within 14 days of grazing or harvest for forage or hay. Do not apply more than 13 fl oz/A per application. Do not make more than 3 applications at 15 fl oz per year. Do not apply more than 39 fl oz/A per year. Revytek may be applied by ground, air or through chemigation. Do not use on rangeland.

Serenade MAX *(QST 713 Strain of Bacillus subtilis)* Mode of Action: Unknown

Application rate: 1 – 3 lbs./A

REI: 4 hours

Targeted diseases: For suppression only of White mold *(Sclerotinia sclerotiorum)*.

Restrictions: Apply after emergence and when conditions are favorable for disease and repeat on a 7 – 10-day interval or as needed. Serenade MAX has a 0-day preharvest interval. Serenade Max may be applied by ground, air or chemigation.

Weed Control in Oilseeds (Canola, Flax, Safflower, Sunflower)

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Herbicide suggestions
Information in this publication is based on label recommendations and SDSU research results. Herbicides are generally only included after the chemical is registered for use in SD. This information is intended as a use summary, but applicators must also check the herbicide labels to verify the recommendations and check for additional application information.

Rates
Information in this publication is based on label recommendations and SDSU research results. Herbicides are generally only included after the chemical is registered for use in SD. This information is intended as a use summary, but applicators must also check the herbicide labels to verify the recommendations and check for additional application information.

Herbicide cost
The estimated cost per acre is listed for low and high rates for the most common formulations. Cost of additives is not included. Consult your dealer for actual prices.

Application timing
EPPS **Early preplant surface:** Application before planting but not incorporated. Primarily for no-till.
PPI **Preplant incorporated:** Application prior to planting with the recommended incorporation method.
PRE **Preemergence:** Application after planting but prior to emergence.
POST **Postemergence:** Application after the crop has emerged.

Resistance management
Diversifying herbicides with different sites of action is critical to minimize the chance of selecting for herbicide-resistant weeds. This may be done by using different herbicides each year and using multiple herbicide sites of action in a single year. Herbicide sites of action are designated by the numbering system developed by the Weed Science Society of America. The table near the front of this section describes the site of action associated with each number.

Sunflower Herbicides
Weeds may reduce sunflower yield even though the infestation is not visually dramatic. The most serious loss from annual weed competition occurs during the first 4 weeks after crop emergence. Herbicides used in sunflowers are not effective on perennial weeds.

- Destroy the first weed flush just before planting with tillage or burndown herbicide. Plant immediately after tillage. Rotary hoe or harrow on a warm, clear day to control seedling weeds. Delay harrowing until sunflowers have four leaves. Increase planting rate 10 to 15% to compensate for stand reduction due to harrowing. A firm seedbed reduces stand loss from harrowing. Row cultivation or postemergence herbicides controls weeds into the season.
- Residue in equipment or drift from application in nearby fields can cause injury. Sunflowers are highly sensitive to herbicides such as 2,4-D, picloram, dicamba, MCPA, Ally, Amber, and other similar herbicides. Use caution to prevent droplet or vapor drift to the sunflower crop when spraying nearby pastures, small grain, or row crops.
- Carryover of herbicides used the previous season may injure sunflowers. Refer to Table 1 for rotation intervals for sunflowers planted the season following herbicide use.

No-Till Sunflowers
Weed control programs for sunflowers are limited. Evaluate herbicide options for anticipated weed problems. Avoid fields with a heavy weed history or where perennial weeds are a problem. Annual broadleaf weeds can be serious; there are no postemergence herbicides for these weeds after the crop emerges. Planting full population in narrow rows effectively reduces late season weed problems. Weeds often develop in areas where the stand is open or not uniform.

Paraquat or glyphosate is used to burn down emerged grasses and broadleaves at planting. Prowl may be used as a surface, early preplant treatment primarily for foxtail control. Poast, Select, or Assure II are approved for postemergence grass control. Spartan has provided very good results in no-till sunflowers. Beyond (imazamox) used in Clearfield sunflower provides postemergence control of several annual broadleaves and some grasses. Express (tribenuron) used in Express sunflowers provides postemergence control of several annual broadleaves. For reduced tillage systems, trifluralin granules fit where residue management is important during the most critical periods. Refer to the section for each herbicide.

Safflower Herbicides
Consider the potential weed problems based on recent weed history. Evaluate the control of potential problems with the limited herbicides available. Early-season control of annuals such as kochia, Russian thistle, and foxtail is important in safflower.

Safflower is not tolerant to some herbicides used in other crops; residue tolerances have been set only for crops listed on the label. It is illegal to use unlabeled herbicides on the crop.

Carryover of herbicides used the previous season may injure safflower. Refer to Table 1 for rotation intervals for safflower planted the season following herbicide use.

Canola Herbicides

Canola and other mustard related plants are sensitive to carryover and drift from several herbicides. Refer to Table 1 for rotation intervals for canola planted the season following herbicide use. Drift from herbicides used to control mustard and other broadleaf weeds can also cause damage. Some labels may have extended planting restriction until there is sufficient data to reduce the application to planting interval for canola.

Group Numbers Associated with Herbicide Sites or Modes of Action

WSSA Group Number	Site or Mode of Action	Examples
1	ACCase inhibitor	clethodim, sethoxydim
2	ALS inhibitor	imazamox
3	Microtubule inhibitor	pendimethalin, trifluralin
4	Growth regulator	clopyralid, MCPA
6	Photosynthesis inhibitor (contact)	bentazon, bromoxynil
8	Lipid synthesis inhibitor (thiocarbamates)	EPTC
9	EPSP inhibitor	glyphosate
10	Glutamine synthetase inhibitor	glufosinate
14	Cell membrane disrupter (PPO inhibitor)	sulfentrazone
15	Seedling shoot inhibitor	metolachlor
22	Cell membrane disrupter (PSI inhibitor)	paraquat
27	Bleacher (HPPD)	mesotrione

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Sunflowers

Safflower

Canola

Flax

TRIFLURALIN PRODUCTS *(trifluralin)* Site of Action: 3 **($4.10–21.70)**

1 – 2 pt Treflan 4EC, Treflan HFP, Trifluralin, Triflurex HFP, or Trust 4L (0.5 – 1 lb. ai)
5 – 12.5 lb. Treflan 10G or Trifluralin 10G (0.5 – 1.25 lb. ai)

Excellent control of most annual grasses and fair control of small-seeded annual broadleaves such as pigweed and lambsquarters. Higher rates give fair kochia control. Wild oat control is not consistent but has been fair in some tests. Does not control large-seeded broadleaves such as, wild mustard, wild sunflower, or cocklebur. Excellent crop tolerance. Rate of 1.5 pt 4L has been satisfactory in most SDSU tests. Carryover may damage oats or sorghum the following year. Granules or spray may be applied in the fall after October 15 or in the spring before planting. Fall application makes it possible to limit spring tillage to a single pass, which serves as the second incorporation. Minimum carrier is 5 gpa for ground or air.

Immediate incorporation is preferred for spray formulations but may be delayed up to 24 hours if soil surface is dry and wind is under 10 mph. Incorporate into the top 2 to 3 inches. A second incorporation improves uniformity, especially under wet, lumpy, or trashy conditions. Follow with a harrow or leveling device. A tandem disk followed by a field cultivator provides good incorporation under a variety of conditions.

Granules preferred for fall application. Incorporate within 24 hours. May be applied in standing stubble. A chisel with sweeps may be used for the first incorporation. A few days delay between incorporations is suggested. Fall-applied granules are especially useful in reduce tillage systems designed to maintain residue in the fall and early spring. Crop residue interferes less with granules than with spray.

SUNFLOWER:
PPI SPRING or FALL: Treflan 4L rate is 1 – 1.5 pt/A on coarse to medium texture soil or 1.5 – 2 pt/A on fine texture soil. Granule 10G rate is 5 – 10 lb./A.

SAFFLOWER
PPI SPRING or FALL: Treflan 4L rate is 1 – 1.5 pt/A on coarse to medium texture soil or 1.5 – 2 pt/A on fine texture soil. May increase the rate by 0.5 pt/A when applying in fall. Granule 10G rate is 5 – 12.5 lb./A.

CANOLA
PPI SPRING or FALL: Treflan 4L rate is 1 pt/A for coarse, 1.5 pt/A for medium, and 2 pt/A for fine texture soil. Granule 10G rate is 5 – 10 lb./A

FLAX
FALL: Treflan 4L rate is 1 pt/A for coarse, 1.5 pt/A for medium, and 2 pt/A for fine texture soil. Spring tillage should be relatively shallow. Granule 10G rate is 5 – 10 lb./A.

PENDIMETHALIN PRODUCTS *(pendimethalin)* Site of Action: 3 **($14.40–25.25)**

2.4 – 3.6 pt Prowl, Acumen, Framework, Pavilion, Pendimethalin, Pin-Dee, or Stealth 3.3 EC (0.99 – 1.5 lb. ai)
2.2 – 3.3 pt Satellite Flex 3.5L (0.96 – 1.44 lb. ai)
2 – 3 pt Prowl H2O, AquaPen, or Satellite Hydrocap 3.8L (0.95 – 1.425 lb. ai)

Very good to excellent control of most annual grasses and fair control of small-seeded broadleaves such as pigweed and lambsquarters. Consistent performance. Does not control large-seeded broadleaves such as, wild mustard, wild sunflower, or cocklebur. Excellent crop tolerance. Minimum carrier is 5 gpa for air or 10 gpa for ground. No label restrictions for crops planted the following year; however, below normal precipitation during the previous year increases carryover risk to sensitive crops. Do not plant winter wheat in the fall if the sunflower crop failed due to dry weather. Prowl H2O is a water-based formulation that has performed well in higher residue and causes less staining.

SUNFLOWER
PPI FALL: Apply in late fall when soil temperature is below 45 degrees F, but before the soil freezes. Incorporate immediately. Use at least one shallow tillage incorporation in the spring before planting. Rates are 3 – 4.2 pt of 3.3L, 2.7 – 3.8 pt of 3.5L, or 2.5 – 3.5 pt of 3.8L per acre.

EPPS: For no-till. Apply up to 30 days before to immediately after planting. Primarily for foxtail, control of lambsquarters and pigweed is more consistent than for other broadleaves. Rates are 3.6 pt of 3.3L, 3.4 pt of 3.5L, or 3 pt of 3.8L per acre. Use the high rate for most soils. Use 20 to 60 gpa carrier. May be tank-mixed with Gramoxone or glyphosate for burndown.

PPI SPRING: Rates are 2.4 – 3.6 pt of 3.3L, 2.2 – 3.3 pt of 3.5L, or 2 – 3 pt of 3.8L per acre. Incorporate within 7 days. Immediate incorporation preferred. Incorporate into the top 1 to 2 inches. Till in crop residue before application. Single-pass incorporation may be adequate if seedbed has been well prepared. Double incorporation insures uniform mixing.

PRE: For conventional till. Apply at planting up to 2 days after planting. Rates are 2.4 – 3.6 pt of 3.3L, 2.2 – 3.3 pt of 3.5L, or 2 – 3 pt of 3.8L per acre.

SAFFLOWER (Prowl H20, AquaPen, Satellite Hydrocap, and Satellite Flex only)
PPI FALL: Apply in late fall when soil temperature is below 45 degrees F, but before the soil freezes. Incorporate immediately. Use at least one shallow tillage incorporation in the spring before planting. Rate is 2.5 – 3.5 pt of 3.8L or 2.7 – 3.8 pt of 3.5L.

EPPS: For no-till apply up to 30 days before to immediately after planting. Rate is 3 pt of 3.8L or 3.4 pt of 3.5L.

PPI SPRING: Rates are 2 – 3 pt of 3.8L or 2.2 – 3.3 pt of 3.5L. Apply within 60 days of planting and incorporate.

PRE: For conventional till. Apply at planting up to 2 days after planting. Rates are 2 – 3 pt of 3.8L or 2.2 – 3.3 pt of 3.5L.

SONALAN *(ethalfluralin)* Site of Action: 3 **($12.10–40.95)**

1.5 – 4.5 pt Sonalan HFP 3L (0.56 – 1.69 lb. ai)
5.5 – 17 lb. Sonalan 10G (0.55 – 1.7 lb. ai)

Excellent control of most annual grasses and fair to good control of small-seeded broadleaves such as pigweed and lambsquarters. Consistent performance. Does not control large-seeded broadleaves such as, wild sunflower, cocklebur, or wild mustard. Gives fair wild oat control. Excellent crop tolerance. Minimum carrier is 5 gpa. Less soil residual than Treflan; no label limitations for common crops for the following year. Do not plant perennial grass crops or grass mixtures for 12 months after a spring application or 18 months if not irrigated. Do not graze or forage treated fields.

SUNFLOWER
Sonalan 3L rate is 1.5 – 4.5 pt/A (5.5 – 17 lb./A of Sonalan 10G) depending on soil type and weed species. Rates are 1.5 – 3 pt/A (5.5 – 11.5 lb./A of 10G) for most weed species or 3–4.5 pt/A (11.5 – 17 lb./A of 10G) for ground cherry and nightshade. Rate of 3 pt of 3L (11.5 lb. of 10G) per acre has been satisfactory in most SDSU tests.

PPI FALL: May be applied after October 1. Incorporate as soon as possible. Do not delay more than 2 days. Second incorporation of granules should be delayed at least 5 days.

PPI SPRING: Incorporate into the top 2 to 3 inches. Immediate incorporation preferred; however, incorporation may be delayed up to 2 days. Second pass may improve uniformity. Delay second incorporation of granules 3 to 5 days.

SAFFLOWER
Sonalan 3L rate is 1.5–2 pt/A (5.5 – 7.5 lb./A of 10G) on coarse, 2 – 2.5 pt/A (7.5 – 9.5 lb./A of 10G) on medium, or 2.5 – 3 pt/A (9.5 – 11.5 lb./A of 10G) on fine texture soils.

PPI SPRING: Follow instructions as described for sunflower.

CANOLA
Sonalan 3L rate is 1.5 pt/A (5.5 lb./A 10G) on coarse, 2 pt/A (7.5 lb./A 10G) on medium, and 2.5 pt/A (9.5 lb./A 10G) on fine soil.

PPI SPRING: Follow instructions as described for sunflower.

EPTAM *(EPTC)* Site of Action: 8 **($21.15–44.40)**

2.5 – 5.25 pt Eptam 7L (2.2 – 4.6 lb. ai)

Excellent control of most annual grasses. Good control of wild oats in most tests. Annual broadleaf control limited. Does not control wild sunflower, wild mustard, kochia, or Russian thistle. Consistent results. Good crop tolerance on medium and heavy soils. Not suggested for light, sandy soil. Minimum carrier is 10 gpa. There is no carryover to following crops. Incorporate into the top 2 to 3 inches. Incorporation time varies with application method: with water (1 hour), with liquid fertilizer (4 hours) or with dry fertilizer (same day). A second incorporation insures uniformity, especially in wet, lumpy, or trashy conditions. Follow with harrow or other leveling devices.

SAFFLOWER
PPI: Rate is 3.5 pt/A. Apply and incorporate just before planting.

SUNFLOWER
PPI FALL: Rate is 4.5 – 5.25 pt/A. Apply in late fall just before ground freezes

PPI: Rate is 2.5 – 3.5 pt/A. Apply and incorporate just before planting.

SUNFLOWER TANK-MIXES
2.25 pt Eptam 7L + 1 – 2 pt trifluralin 4L (2 + 0.5 – 1 lb. ai)

Excellent control of several annual grasses. Tank-mixes appear to have limited advantage for most weed problems when compared to the full rate of each herbicide used alone. Very good to excellent wild oat control compared to trifluralin alone. Lower trifluralin rates reduce carryover for sensitive crops. Rates of Eptam at 2.25 pt plus 1 to 1.5 pt trifluralin 4L per acre are adequate for most situations. Minimum carrier is 10 gpa. Note carryover restrictions for trifluralin.

SULFENTRAZONE PRODUCTS *(sulfentrazone)* Site of Action: 14 **($3.80–16.15)**

3 – 8 oz Spartan, Antares, Aquesta, Arterio, Blanket, Intensa, Sulfen, Sulfentrazone, Sulfin, Vandal, or Zone 4F (0.098 – 0.25 lb. ai)
3 – 7.8 oz Shutdown 4.16L (0.098 – 0.25 lb. ai)

Spartan is a soil-applied herbicide with root and shoot activity. Spartan is used primarily for annual broadleaf weeds including pigweed, kochia (including glyphosate- and ALS-inhibiting herbicide-resistant), and black nightshade. Fair to good control of wild buckwheat and lambsquarters is possible under favorable conditions. Activity on biennial wormwood has been reported.

Rates vary with soil texture. Use 3.75 – 6.0 oz/A for most soils (O.M. 1 – 3%). SDSU trials often based on 6 oz/A rate. Lowest rate is for coarse to moderate texture soil with less than 1.5% O.M. The high rate is suggested for heavy soil, especially if applied considerably before planting. Crop tolerance has been satisfactory in SDSU tests. Allow 7 – 14 days between application and planting on coarse soils with <1.5% O.M. Do not use on sandy soils with less than 1% O.M. Failure to adequately close the seed furrow may result in crop injury. Minimum carrier is 10 gpa for ground or 5 gpa for air equipment.

Spartan may be tank-mixed in sunflowers with Prowl or other soil applied herbicides for added residual control or with burndown herbicides to control emerged weeds.

SUNFLOWER
FALL: Spartan labeling includes application as a burndown with residual in late summer, fall, or early spring prior to planting labeled crops. Do not apply to frozen soil. Use mid to high rates for the appropriate soil type. Fall/spring split applications have performed very well.

EPPS: Use high rate for appropriate soil type for applications more than 3 weeks prior to planting. Add COC to improve burndown on small broadleaf weeds. Add glyphosate to control emerged annual and/or perennials weeds.

PPI: Shallow incorporation into top 2 inches of soil.

PRE: Rainfall required before weed emergence. Apply within 3 days after planting.

FLAX (Not all products labeled for flax.)
PRE: Apply 2.25 – 8 oz. Some products labeled up to 12 oz. Rate based on soil texture, OM and pH. Apply prior to planting or after planting but before emergence.

Maximum of 12 oz/A per 12-month period (11.8 oz/A for Shutdown).

SPARTAN CHARGE *(sulfentrazone + carfentrazone)* Site of Action: 14 + 14 **($11.60–31.50)**

3.75 – 10.2 oz Spartan Charge 3.5L (0.09 – 0.25 + 0.01 – 0.03 lbs. ai)

Rates vary by soil texture, organic matter (O.M.), and soil pH. Spartan Charge at 5.5 fl oz/A contains the equivalent active ingredients as Spartan 4F at 4.3 fl oz/A and Aim at 1 oz/A. Thorough coverage is important for foliar weed control. May be tank-mixed with glyphosate, or paraquat for burndown applications. Do not apply on soils classified as sand with less than 1% O.M.

Properly closed seed furrows are required when applying at plant or before seed germination. Minimize soil disturbance if planting after application. When tank mixing, add Spartan Charge first. Risk of injury is greatest on coarse soils with less than 1.5% O.M. and pH of 7.8 or greater for sunflowers or 7 or greater for flax. Reduce rates or avoid application on high-risk soils. Crop stress may also increase the risk of crop injury.

SUNFLOWER
FALL: Do not mechanically incorporate. Do not apply to frozen or snow-covered soil. Use mid to high rates appropriate for the soil texture and O.M.

EPPS or PRE: For applications earlier than 3 weeks prior to planting, use the high rate appropriate for the soil texture and O.M. Apply prior to planting or up to 3 days after planting for pre-emerge control. Weed control may be reduced if 0.5 – 1 inch of precipitation is not received within 7 – 10 days prior to planting.

FLAX
FALL, PREPLANT BURNDOWN, EPP, PRE: Rate based on soil texture and O.M. Fall, Do not mechanically incorporate. Do not apply to frozen soils. Spring, Apply prior to planting or up to 3 days after planting for pre-emerge control. Weed control may be reduced if 0.5 – 1 inch of precipitation is not received within 7 – 10 days prior to planting.

AUTHORITY SUPREME *(sulfentrazone + pyroxasulfone)* Site of Action: 14 + 15 **($22.35–78.25)**
AUTHORITY EDGE *(sulfentrazone + pyroxasulfone)*

5.8 – 15.4 oz Authority Supreme (0.094 – 0.25 + 0.094 – 0.25 lb. ai)
4.4 – 11.7 oz Authority Edge (0.094 – 0.25 + 0.05 – 0.14 lb. ai)

Authority Supreme contains 2.08 lb. sulfentrazone and 2.08 lb. pyroxasulfone per gallon and Authority Edge contains 2.73 lb. sulfentrazone and 1.52 lb. pyroxasulfone per gallon. Controls certain broadleaf, grass, and sedge weeds. Within 7 – 10 days after application, 0.5 – 1 inch of rain is needed to activate herbicide. Rates vary depending on soil texture and O.M. Do not use on sand soils with less than 1% O.M. Do not apply after germination of crop. Maximum use rate per crop year is 15.4 oz/A for Authority Supreme and 11.7 oz/A for Authority Edge. Do not graze or feed forage, hay or straw from treated areas for 30 days. Sunflowers may be planted anytime. Refer to label for other crop rotations as the rotation varies by use rate for each crop.

SUNFLOWER
FALL: Apply after September 30 when the soil temperature is less than 55 degrees F. Do not apply to frozen or snow-covered soils.

EPPS, PPI, PRE: Apply up to 3 days after planting but before crop emergence. Label suggests preplant surface application on medium to fine soils with minimum till or no-till systems in South Dakota. Incorporate uniformly no deeper than 2 inches.

BROADAXE XC, AUTHORITY ELITE, or SPARTAN ELITE **($17.75–48.85)**
(sulfentrazone + s-metolachlor) Site of Action: 14 + 15

19 – 38.7 oz BroadAxe XC, Authority Elite or Spartan Elite 7L (0.1 – 0.2 + 0.9 – 1.9 lb. ai)
17 – 38.7 oz Sulfen Elite 7L (0.09 – 0.2 + 0.84 – 1.9 lb. ai)

Rates vary by soil texture, organic matter (O.M.), and pH. BroadAxe XC at 25 fl oz/A contains the equivalent active ingredients as Spartan 4F at 4 fl oz/A and Dual II Magnum at 21 oz/A. Rates less than 25 fl oz/A may result in incomplete weed control. Plant sunflowers 1.5 inches deep and completely cover seeds. Risk of crop injury on coarse texture soils with less than 1.5% O.M. and pH 7.2 or greater or highly eroded soils, hilltops, or calcareous outcroppings. Either avoid application on these areas or use the low rate (19 oz/A) on high-risk soils. Adverse weather conditions, such as excessive moisture, cold temperatures,

soil compaction, or disease may increase the risk of crop response. Approximately 0.5 – 1 inch precipitation is needed within 7 – 10 days after application to incorporate the herbicide. If this does not occur, the herbicide may be incorporated with a shallow (less than 2 inches) tillage. If applied on coarse soils with less than 1.5% O.M., wait at least 7 days before incorporating. Do not use on sandy soils with less than 1% O.M.

Do not apply more than 38.7 fl oz per acre per year. Do not apply other sulfentrazone products the same year as a BroadAxe XC application. Do not apply to frozen soils or to existing snow cover. Do not allow livestock to graze treated areas.

SUNFLOWER
PPI: May be applied up to 2 weeks prior to sunflower planting. Incorporation should not exceed 2 inches deep.

PRE: Apply up to 3 days after planting. Significant injury may occur if applied to emerging sunflowers.

METOLACHLOR PRODUCTS ***(s-metolachlor)*** Site of Action: 15 **($8.15–25.95)**

1 – 2 pt Dual Magnum, Brawl, Charger Basic, EverpreX, Medal, Visor S-MOC 7.62L (0.95 – 1.9 lb. ai)
1 – 2 pt Dual II Magnum, Brawl II, Charger Max, Cinch, Medal II, Moccasin II Plus, StreliuS II, Visor S-MOC II 7.64L (0.95 – 1.9 lb. ai)
1 – 1.9 pt Moccasin 8L (1 – 1.9 lb. ai)

Dual is used primarily for annual grass control. Results on foxtail have been fair to excellent, depending on timeliness of rainfall. Provides limited activity on broadleaves such as pigweed. Crop tolerance in SDSU tests has been excellent. Rates depend on soil type and organic matter. Rates of 1.5 to 2 pt per acre have been satisfactory in SDSU tests. Minimum carrier is 5 to 10 gpa for ground or 2 gpa for air. Do not allow livestock to graze or feed in treated areas.

Check individual labels. Not all products are labeled for both crops.

SUNFLOWER
PPI: Incorporate shallowly into the top 2 inches. Avoid deep or uneven incorporation.

PRE: Apply after planting but before crop or weed emergence.

SAFFLOWER
PPI or PRE: Follow directions for s-metolachlor as described for sunflower. In addition, Stalwart C (1 – 1.67 pt/A depending on soil type and % organic matter), Helmet, Metalica, Me-Too-Lachlor, Parallel and Priority 8E (1 – 2 pt/A) are metolachlor (not s-metolachlor) products labeled for use in safflower only. S-metolachlor is generally considered to be a more active isomer of metolachlor, but SDSU trials have demonstrated that weed control is often similar between metolachlor and s-metolachlor products.

SEQUENCE ***(s-metolachlor + glyphosate)*** Site of Action: 15 + 9 **($22.10–24.30)**

2.5 – 2.75 pt Sequence (0.94 – 1.03 + 0.7 – 0.8 lb. ai)

For foliar activity on many weed species and residual activity on annual grass weed species. Control may be best if weeds are less than 6 inches tall. May add AMS (8.5 – 17 lbs./100 gallons spray solution) to improve weed control. Carrier rate should be 10 – 40 gpa for ground applications or 3 – 15 gpa for aerial applications.

SUNFLOWER
PPS or PRE: Apply before, during, or immediately after planting but prior to crop emergence. Make only one application per year. Do not apply more than 2.5 – 2.75 pt/A per year. May tank mix with Eptam, Prowl, or trifluralin (e.g., Treflan).

ZIDUA ***(pyroxasulfone)*** Site of Action: 15 **($13.05–44.70)**

1 – 4 oz Zidua 85WG (0.053 – 0.213 lb. ai)
1.75 – 6 oz Zidua SC 4.17L (0.057 – 0.195 lb. ai)

Zidua is a selective herbicide that provides control of annual broadleaves, grasses, and sedges. Rates vary depending on soil type. At least 0.5 inch of rain is needed for activation following application. Maximum cumulative rate is 1.5 oz/A on coarse soils and 5 oz/A on all other soils. Sequential applications should be separated by 14 days. Can be tank-mixed or sequentially applied with fungicides and insecticides. Minimum carrier volume is 5 gpa for ground or 3 gpa for aerial application. Verify your hybrid/variety tolerance to avoid potential crop injury.

SUNFLOWER
EPPS or PRE: Apply 1 – 4 oz/A WG or 1.75 – 6 oz SC. Do not apply at cracking or cotyledon stage. Prepare seedbed to ensure proper row closure and soil coverage of seed. Do not apply preplant incorporated. If tank-mixing with an herbicide other than glyphosate or a graminicide, use the lower rate based on soil texture.

EPOST: Apply 1 – 2 oz/A WG or 1.75 – 3.25 oz SC from V1 to V8 stage. Emerged weeds are not controlled. May cause some leaf burn and stunting, however effects are temporary. Do not apply more than 1 oz/A if tank-mixed with another herbicide other than a graminicide. Do not apply within 60 days of harvest.

SAFFLOWER
PRE: Apply 1 – 1.5 oz/A WG or 1.75 – 2.5 oz SC after planting and before crop emergence. Do not apply at cracking or cotyledon stage. Prepare seedbed to ensure proper row closure and soil coverage of seed. Do not apply preplant incorporated. If tank-mixing with an herbicide other than glyphosate or a graminicide, use the lower rate based on soil texture

ANTHEM FLEX *(pyroxasulfone + carfentrazone)* Site of Action: 15 + 14 **($11.50–41.95)**

2 – 7.3 oz Anthem Flex 4L (0.058 – 0.213 + 0.004 – 0.015 lb. ai)

Anthem Flex contains 3.733 lb. per gallon of pyroxasulfone and 0.267 lb. per gallon of carfentrazone. Provides control of annual grasses and broadleaves. Rates vary depending on soil type and organic matter.

Allow 14 days between applications with a maximum of 3 applications per year. The maximum single application rate is 7.3 oz and the maximum rate per year is 9.12 oz. For burndown add NIS (0.25%), COC (1 – 2 pt) or MSO (1 – 2 pt). May also add UAN (1 – 2 qt) or AMS. Minimum carrier is 5 gpa for ground or 3 gpa for aerial applications.

SUNFLOWER
FALL, EPP, PPI or PRE: Use higher rates for EPP (15 – 45 days) and reduced tillage systems. Make PRE applications before sunflower cracking or emergence. Plant sunflowers a minimum of 1 inch deep and ensure proper row closure and soil coverage to prevent injury.

POAST *(sethoxydim)* Site of Action: 1 **($8.30–41.50)**

0.5 – 2.5 pt Poast 1.5L (0.1 – 0.5 lb. ai)

Very good control of annual grass and suppression of quackgrass. Use 0.5 pt for wild proso millet (10 in); 0.75 pt for foxtail (4 in); 1 pt for foxtail (8 in) or wild oat (4 in); 1.2 pt for sandbur (3 in); and 1.5 pt for volunteer cereal (4 in) per acre. Results for quackgrass are best with a split application of 1.5 pt followed by 1 pt per acre with COC and 28% N or AMS.

Cultivation 7 days after application improves quackgrass control. Grasses should be actively growing. Do not cultivate 5 days before or 7 days after application. Minimum carrier is 5 gpa for ground or air. Minimum pressure is 40 psi for ground. Good coverage improves results.

Always add COC (2 pt/A) or MSO (1.5 pt/A). Add AMS (2.5 lb./A) or UAN (2 – 4 qt/A) to improve control of volunteer cereal, wild oat, and quackgrass.

SUNFLOWER, SAFFLOWER, CANOLA
POST: Timing and rates based on weed species and weed height. Maximum application rate is 2.5 pt/A for most crops. Do not let livestock feed or forage on treated fields.

FLAX
POST: Maximum application rate is 1.5 pt/A for flax. May tank-mix with bromoxynil, or MCPA. However, mixing with these herbicides may cause flax leaf burn and stunting. Do not add AMS or UAN when tank mixing with these broadleaf herbicides..

CLETHODIM PRODUCTS *(clethodim)* Site of Action: 1 **($2.10–32.35)**

4 – 16 oz Select, Arrow, Avatar, Ceridian, Cleanse, Clethodim, Gatlin, Intensity, Shadow, Trizenta, Vaquero, Volunteer 2L
9 – 32 oz Select Max, Intensity One, Tapout 1L
2.67 – 10.7 oz Section Three, Shadow 3EC, or Trizenta 3EC 3L (0.09 – 0.25 lb. ai)

Very good to excellent control of annual grasses. Provides quackgrass suppression. Grasses should be actively growing as control may decline during drought stress. Do not cultivate one week before or after application. Apply when annual weeds are 2–6 inches tall. Use lower rates for annuals and higher rates for perennials. Rates vary by crop. Allow 14 days between applications if making more than one application per season.

Minimum carrier volume is 5 gpa (10 gpa for dense canopies and during drought stress) for ground applications or 3 gpa for aerial applications. Thorough coverage improves control. The addition of an adjuvant is required, see individual label for specific recommendations.

Check individual labels. Not all products are labeled for all crops.

SUNFLOWER POST: Use 9 – 32 oz/A (1L), 6 – 16 oz/A (2L), or 4 – 10.67 oz/A (3L). Lower rates are for small annual grasses. Preharvest interval is 70 days.

SAFFLOWER POST: Use 9 – 16 oz/A (1L), 6–8 oz/A (2L), or 4 – 5.33 oz/A (3L). Lower rates are for small annual grasses. Preharvest interval is 70 days.

CANOLA POST: Use 9 – 12 oz/A (1L), 4 – 6 oz/A (2L), or 2.67 – 5.33 oz/A (3L). Apply prior to canola bolting or bloom to prevent crop injury. Preharvest interval is 70 days. Do not apply more than 12 fl. oz/A of 1L product, 6 fl oz/A of 2L product or 5.33 fl oz/A of 3L product per season.

FLAX POST: Use 9 – 16 oz/A (1L), 6 – 8 oz/A (2L), or 4 – 5.33 oz/A (3L). Apply prior to bloom to prevent crop injury. Lower rates are for small annual grasses. Preharvest interval is 60 days.

ASSURE II, TARGA, SE-CURE, QUIZ *(quizalofop)* Site of Action: 1 **($4.10–9.90)**

5 – 12 oz Assure II, Targa, Se-Cure or Quiz 0.88L (0.03 – 0.08 lb. ai)

Controls several annual grass species and suppresses quackgrass. Apply when annual grass weeds are 2 – 6 inches tall and actively growing for most species. For repeated applications, allow at least 7 days between applications. Do not cultivate one week before or after application. Do not apply if rainfall is expected within 1 hour of application. Do not graze or feed treated foliage to livestock.

Apply 5 – 8 oz/A for volunteer corn and proso millet, 7 – 8 oz/A for other annual grasses, and 10 – 12 oz/A for quackgrass. See label for specific rates for specific species.

Add NIS at 0.25% v/v or COC 1% v/v of spray solution. For aerial applications, COC may be applied at 0.5% v/v of spray solution. UAN at 2 qt/A or AMS at 2 lb./A may be added in addition to NIS (double nitrogen rate under arid conditions). Minimum carrier is 10 gpa for ground or 3 gpa for aerial applications. Increase carrier rate by 50% in dry areas. Weed control may decline if applied during drought stress.

SUNFLOWER POST: Do not apply within 60 days of harvest. Avoid application if sunflowers are stressed. Maximum use rate is 18 oz per year

CANOLA POST: Do not apply within 60 days of harvest. Maximum use rate is 18 oz per year.

FLAX POST: Do not apply within 70 days of harvest. Maximum use rate is 24 oz per year.

HARMONY *(thifensulfuron)* Site of Action: 2 **($21.75–28.95)**

0.45 – 0.6 oz Harmony 50SG

Postemergence control of some broadleaf weed species, such as mustard species, lambsquarters, pigweed, and wild buckwheat. Will not control ALS-inhibiting herbicide-resistant kochia. Sequential treatments may be made if the total use rate per crop season does not exceed 0.6 oz/A. Must be applied at least 81 days prior to harvest. Rotation restriction is 45 days for most crop species.

SAFFLOWER POST: Best if applied to small broadleaf weeds. Add NIS at 0.25% v/v and either 28% UAN (2 – 4 qt/A) or AMS (2 – 4 lb./A).

STINGER, BITE, CLEAN SLATE, SINDER, SPUR, STIGMATA *(clopyralid)* Site of Action: 4 **($4.40–10.05)**

0.25 – 0.5 pt Stinger, Bite, Clean Slate, Sinder, Spur or Stigmata 3L (0.09 – 0.18 lb. ae)
0.15 – 0.3 pt Stinger HL 5L (0.09 – 0.18 lb. ae)

CANOLA POST: Especially effective for Canada thistle; also controls annual broadleaves such as sunflower, common and giant ragweed, nightshade species and wild buckwheat. Use the high rate for Canada thistle. Apply when canola is in the 2 to 6 leaf growth stage. Do not apply within 50 days of harvest. Make one broadcast application per crop year.

MCPA AMINE or MCPA ESTER Site of Action: 4 **($1.60–5.65)**

0.25 lb. ae MCPA amine or MCPA ester (0.25 lb. ae)

FLAX POST: Apply when flax is 2 to 6 inches tall but before buds form. Treat before weeds are 4 inches tall. Fair to good control of mustard and lambsquarters; poor on kochia or wild buckwheat. Fair to good crop tolerance. Avoid treating during drought stress. Flax may be under seeded to alfalfa. Not labeled for preharvest application.

BROMOXYNIL PRODUCTS *(bromoxynil)* Site of Action: 6
BROMOXYNIL + MCPA PRODUCTS *(bromoxynil + MCPA)* Site of Action: 6 + 4

1 pt bromoxynil 2L (0.25 lb. ae)
0.9 pt bromoxynil/MCPA 4L or 0.7 pt bromoxynil/MCPA 5L (0.2 + 0.2 lb. ae)

Trade Names	Acid equivalent (lb./gal)
Broclean, Brox, Maestro, Moxy	2 lb. bromoxynil
Bison, Bromac, Brox-M, Maestro MA, Paver, Vendetta, WildCard Xtra	2 lb. bromoxynil + 2 lb. MCPA
Bromac Advanced, Maestro Advanced	2.5 lb. bromoxynil + 2.5 lb. MCPA

FLAX POST: Adjust rate according to the specific product label. Some 4L products labeled at 0.5 – 0.9 pt/A. Apply when flax is 2 to 8 inches tall and weeds are in 2- to 4-leaf stage. Excellent wild buckwheat and good kochia control. Also controls several other annual broadleaves but is weak on wild mustard. Fair crop tolerance. Best crop tolerance when flax is small. Do not apply at bud stage or in humid weather when temperature is over 85 degrees F. Minimum carrier is 10 gpa for ground and 5 gpa for air. May be under seeded to alfalfa when using bromoxynil.

CURTAIL M *(clopyralid + MCPA)* Site of Action: 4 **($8.30)**

0.85 pt Curtail M 2.77L (0.045 + 0.25 lb. ai)

FLAX POST: Product contains 0.42 lb. clopyralid (Stinger) + 2.35 lb. MCPA ester/gal. Apply when flax is 2 to 6 inches tall. Good Canada thistle control. Also controls wild mustard, small lambsquarters, wild buckwheat, and other susceptible annual broadleaves. Fair to good crop tolerance. May be tank-mixed with other labeled herbicides, including postemergence herbicides for grass control. Not for flax under seeded to alfalfa. Do not apply within 72 days of harvest.

MESOTRIONE PRODUCTS *(mesotrione)* Site of Action: 27 ($7.50–17.65)

6 oz Callisto, Argos, Carabiner, Cavallo, Explorer, Incinerate, Meso, Meso Star, Mesotrione, MesoTryOne, Motif, Seeker or Sotrion 4L (0.19 lb. ai)

Intended for foliar and residual control of several common broadleaf weed species and crabgrass suppression. If weeds have emerged at the time of application, add COC at 1% v/v of spray solution. UAN (28% N) at 2.5% v/v or AMS at 8.5 lbs./100 gallons spray solution may also be added to improve activity on emerged weeds.

FLAX
PRE: Apply up to 6 fl oz/A after planting but prior to flax emergence. Severe injury may occur if crop has emerged.

AIM, ANTIK, or LONGBOW *(carfentrazone)* Site of Action: 14 ($3.90–15.55)

0.5 – 2 oz Aim, Antik, Longbow 2EC (0.008 – 0.03 lb. ai)

SUNFLOWER, SAFFLOWER, CANOLA, or FLAX
BURNDOWN: Apply 0.5 – 2 oz/A prior to planting up to 24 hours after planting. Most effective on small weeds less than 4 inches tall or rosettes less than 3 inches wide. Tank mix with glyphosate or paraquat for broad spectrum weed control. Use NIS (0.25% v/v), COC (1 – 2% v/v), or MSO (1 – 2% v/v) and may add either liquid nitrogen fertilizer (2 – 4% v/v) or AMS (2 – 4 lb./A).

SUNFLOWER (Aim, Longbow only)
HOODED SPRAYER APPLICATION: Apply 0.5 to 2 fl oz/A with rates depending on weed species. Avoid spray contact with sunflower foliage. Minimum carrier volume is 10 gpa. Do not travel faster than 5 mph.

FLAX
HARVEST AID: Apply 1 – 6.1 oz/A when 75% of bolls are brown. MSO at 1 – 2% v/v preferred. Carrier volume is 15 – 30 gpa. Pre-harvest interval is 0 days.

VIDA *(pyraflufen)* Site of Action: 14 ($2.20–8.90)

0.5 – 2 oz Vida 0.2L (0.0008 – 0.0032 lb. ai)

Vida is a contact herbicide with the same mode of action as Aim (carfentrazone). Vida has activity on broadleaf weeds including cocklebur, lambsquarters, pigweed, Russian thistle, sunflower, wild buckwheat, and wild mustard. Vida is used primarily in a tank-mix with glyphosate. Results used alone have been variable; especially for kochia. Do not graze treated area.

SUNFLOWER, SAFFLOWER, CANOLA, or FLAX
PREPLANT BURNDOWN: Apply 0.5 – 2 fl oz/A of Vida. Do not apply within 1 day of planting. Recommended adjuvants include NIS at 0.25 % v/v or COC at 1% v/v. Minimum carrier is 10 gpa for ground application. Allow 30 days between applications. Maximum of 3 applications or 5.5 oz/A per year.

FLUMIOXAZIN PRODUCTS *(flumioxazin)* Site of Action: 14 ($3.10–21.85)

1 – 4 oz Valor, Flumi 51, Flumi SX, Tuscany, Valkos, or Zaltus SX 51WDG (0.032 – 0.128 lb. ai)
1 – 4 oz Valor EZ, Panther SC, Tuscany SC, Valkos SC, or Zaltus SC 4L (0.031 – 0.125 lb. ai)

SUNFLOWER, SAFFLOWER, FLAX
FALL: Apply 2 – 4 oz for sunflower, safflower, or flax. Fall burndown used with labeled burndown herbicides to enhance speed of burndown, increase weed spectrum and provide some residual control until spring. Do not apply to frozen or snow-covered soil. Be sure to follow crop rotation intervals in spring.

SUNFLOWER ONLY
EPP: Apply 1 to 2 oz. Spring applied with labeled burndown herbicides to improve burndown activity. Must apply a minimum of 30 days before planting with at least one inch of moisture,

SUNFLOWER, SAFFLOWER, FLAX
HARVEST AID: Tuscany is not labeled for harvest aid. Apply 1.5 – 2 oz with 1 qt MSO and 2 – 2.5 lb. AMS or 1 – 2 qt 28% N. Apply in flax after 75% of the bolls are brown in color. For sunflowers and safflower, apply after the seed is below 35% moisture. Apply with minimum of 15 gpa. Do not harvest for at least 5 days.

PARAQUAT PRODUCTS *(paraquat)* Site of Action: 22 **Restricted Use Pesticide**

2.5 – 4 pt Gramoxone 2.0 **($9.65–20.80)**
1.7 – 2.7 pt Devour, Gramoxone 3.0, Helmquat, Paraquat, Para-Shot, Quik-Quat 3L (0.5 – 1.0 lb. ai)

SUNFLOWER, SAFFLOWER
BURNDOWN: Paraquat is a non-selective, contact herbicide used for burndown in no-till or reduced-tillage systems. No residual activity. Minimum carrier is 10 gpa for ground or 5 gpa for air. Add NIS at 1 to 2 pt or COC at 1 gal/100 gal for ground. Use NIS at 2 pt or COC at 1 pt/100 gal for air. Follow handling precautions. Paraquat is highly toxic if ingested.

1.2 – 2 pt Gramoxone 2.0 **($4.55–10.05)**
0.8 – 1.3 pt Devour, Gramoxone 3.0, Helmquat, Paraquat, Para-Shot, Quik-Quat 3L (0.3 – 0.5 lb. ai)

SUNFLOWER
HARVEST AID: Desiccant for oil seed and confection varieties. Provides more rapid drying in late, wet fall or to hasten drying of less mature plants within a field. Generally, not necessary in normal seasons. Apply at physiological maturity, when the back side of the head is yellow, and bracts around the outer edge of the head are turning brown. This usually corresponds to seed moisture of 35% or less. Earlier application will reduce yield and test weight. Minimum carrier is 10 gpa for ground; 5 gpa for air. Add NIS at 1 to 2 pt or COC at 1 gal/100 gal for ground. Use NIS at 2 pt or COC at 1 pt/100 gal for air. Follow handling precautions. Paraquat is toxic if ingested. Allow 7 days after application till harvest. Do not graze treated areas or feed treated forage to livestock.

DIQUAT PRODUCTS *(diquat)* Site of Action: 22 **($18.45–26.65)**

1.5 – 2 pt Diquat, Capone Desiccant, Reglone, Verdure-X 2L (0.5 – 1.0 lb. ai)

CANOLA
HARVEST AID: Diquat is a non-selective, contact herbicide used for preharvest desiccation. Provides more rapid drying in late, wet fall or to hasten drying of less mature plants within a field. Apply after crop is mature. Preharvest interval is 7 days. For best results, harvest no later than 10 days after application. Make only one application per season. Minimum carrier is 15 gpa for ground or 5 gpa for air. Add NIS at 0.5 – 4 pt/100gal.

GLYPHOSATE PRODUCTS *(glyphosate)* Site of Action: 9 **($3.90–9.95)**

Glyphosate is available in several products having different formulations and concentrations; however only certain products are labeled for burndown in specific crops. Check specific product label.

16 – 32 oz 3 lb. ae (0.38 – 0.75 lb. ae)
12 – 24 oz 4 lb. ae (0.38 – 0.75 lb. ae)
11 – 22 oz 4.5 lb. ae (0.38 – 0.75 lb. ae)

Glyphosate is a non-selective translocated herbicide with no soil residual activity. It controls both grasses and broadleaf species. It is used as a burndown for annual weeds or to suppress emerged perennials prior to crop emergence. Rates above are adequate for preplant burndown for small, susceptible annuals; the high rate for larger, mixed populations and for suppression of perennials. Carrier is 3 to 40 gpa for ground and 3 to 15 gpa for air. Maximum rate for air is 1 qt of 3 lb. ae product. Adjust rates according to formulation.

SUNFLOWER, SAFFLOWER, CANOLA, FLAX
BURNDOWN: Apply prior to planting or after planting but before crop emergence. Do not add 2,4-D or other non-labeled herbicides.

SUNFLOWER, SAFFLOWER
PRE-HARVEST: Some products are registered for pre-harvest applications. Apply no more than 22 oz/A of the 4.5L. For sunflower, apply after sunflower plants are mature (seed less than 35% moisture, back of heads are turning yellow, and the bracts are turning brown). For safflower, apply after the safflower seeds have lost their opaque color, which is approximately 20 – 30 days after the end of flowering on the secondary branches.

SUNFLOWER
HOODED SPRAYER APPLICATION: Certain labeled glyphosate products allow use through hooded sprayers to control weeds between the rows. The spray unit must completely enclose the spray pattern. Spray particles that escape and contact the crop will cause damage. Maximum rate is 1 qt of 3 lb. ae per acre. Sunflowers must be at least 12 inches tall; leave an 8-inch untreated strip over the row. Maximum tractor speed is 5 mph. This application is useful for weeds between the row; including perennials. However, a program to control early season weeds and weeds in the row is required to prevent early weed competition.

SHARPEN *(saflufenacil)* Site of Action: 14 **($8.25–16.45)**

1 – 2 oz Sharpen 2.85L (0.02 – 0.04 lb. ai)

SUNFLOWER, SAFFLOWER, CANOLA, FLAX
HARVEST AID: May be used only as a harvest aid/desiccant. Apply when crops are mature. For flax, apply when 70 – 80% of bolls are brown. For canola, apply when seeds in middle pods start to turn brown. Apply when seed moisture is less than 36% on sunflower. Maturity may be visually estimated as the time when the backs of the sunflower heads are yellow and the leafy bracts on the heads are beginning to turn brown. Apply at least 3 days (canola or flax) or 7 days (sunflower or safflower) prior to harvesting.

May tank-mix with glyphosate for added weed control on sunflower or safflower. Add an MSO at 1% v/v spray solution. Up to two applications may be made, but the cumulative amount applied cannot exceed 4 oz per season. Do not apply to crops grown for seed..

DEFOL 5 *(sodium chlorate)* **($12.80)**

4.8 qt Defol 5 5L (6 lb. ai)

Harvest aid desiccant for oil seed or confectionary varieties. Useful to facilitate harvest when fall conditions are unfavorable. Also reduces bird damage associated with harvest delay. Contact action. Apply when crop is fully mature. May add NIS or COC. Minimum carrier is 5 to 10 gpa for air or 20 to 30 gpa for ground.

SUNFLOWER, SAFFLOWER, FLAX
HARVEST AID: Apply to mature heads at least 7 days before normal harvest. Treated fields of sunflower and flax cannot be grazed or used for forage for 14 days after treatment. Safflower cannot be grazed or foraged.

Herbicide Resistant Crops

ROUNDUP READY CANOLA **($3.90–9.95)**

Several products are labeled for in-crop use in canola containing the Roundup Ready gene. Check specific product label for approval.l.

POST IN-CROP: Rates for several glyphosate product formulations for Roundup Ready in-crop application are listed below.

Glyphosate Product	Single Application	Maximum In-Crop
3 lb. ae	16–24 oz	32 oz
4 lb. ae	12–18 oz	24 oz
4.5 lb. ae	11–22 oz	22 oz

Apply before the 6-leaf stage. May be followed by a sequential application at the low rate at a minimum interval of 10 days. Allow 60 days between application and harvest. Adjust rate for formulation.

Make applications early when weeds are small to maximize yield potential. Repeat applications may be required for perennials. Apply with aerial or ground equipment. Avoid drift.

LIBERTY LINK CANOLA
GLUFOSINATE PRODUCTS *(glufosinate)* Site of Action: 10 **($13.35–19.45)**

22 oz Forfeit 280, Glufosinate 280 SL(OT), Inflame 280SL, Reckon 280, or Surmise 2.34L (0.4 lb. ai)
22 – 29 oz Liberty, Cheetah, Fever, Interline, Noventa, Nullify A/P, or Total SL 2.34L (0.4 – 0.53 lb. ai)
15 – 19 oz Liberty ULTRA (0.2 – 0.26 lb. ai)
11 – 14.5 oz Surmise 5 (0.40 – 0.52 lb. ai)

Only for use in glufosinate-tolerant canola designated as Liberty Link seed.

Glufosinate is a non-selective, non-residual, water soluble postemergence herbicide. Glufosinate provides rapid activity on weeds after application. Controls many broadleaf weeds and some annual grasses. Provides suppression of perennial weeds.

Slight discoloration of canola may be visible after application and will not influence crop growth, maturity, or yield. Weeds that emerge after application will not be controlled. Sequential postemergence applications can be made 10 to 14 days apart. Liberty ULTRA can be applied sequentially with a minimum of 7 days between applications. Do not make more than 2 applications of glufosinate per growing season. Rainfast in 4 hours after application. Minimum carrier is 15 gpa water for ground application or 10 gpa for aerial application. Must be applied with AMS at 1.5 – 3 lb./A (check individual label). Do not add surfactants or crop oil. Anti-foam or drift agents may be added if needed.

Do not apply when wind causes drift to desirable or off-target vegetation. Do not cultivate 5 days before or 5 days after application. Do not apply within 65 days of harvest or graze treated crop or cut for hay. If Forfeit 280, Glufosinate 280 SL(OT), Inflame 280SL, Interline, Reckon 280, or Surmise were applied as a burndown, do not apply postemergence. To improve grass control, may tank-mix with Assure II (4 – 5 fl oz/A), Poast (6 – 8 fl oz/A), Select 2EC (2 – 3 fl oz/A), or Select Max (4 – 6 fl oz/A). Crops with the Liberty Link designation may be planted at any time.

POST: Applications may be made from cotyledon to early bolting stage of canola.

ZALO *(glufosinate + quizalofop)* Site of Action: 10 + 1

22 – 29 oz Zalo (0.39 - 0.52 + 0.04 - 0.052 lb. ai)

Postemergence control of annual broadleaf and grass weeds. Some perennial grasses are controlled. Weeds should be 3 inches or less at the time of application or ineffective control can occur.

Slight discoloration of canola may be visible after application and will not influence crop growth, maturity, or yield. Do not make more than 2 applications per growing season. Do not reapply within 7 days of the previous application. Rainfast 4

hours after application. Requires the use of a surfactant. Use COC, MSO, at 1% v/v. Use NIS at 0.25 to 0.5% v/v. HSOC can be used at 0.5% Must be applied with AMS at 3 lb./A. Minimum carrier is 15 gpa water for ground application or 10 gpa for aerial application. 20 gpa is preferred for ground application.

Do not apply when wind causes drift to desirable or off-target vegetation. Do not cultivate 5 days before or 7 days after application. Do not apply within 65 days of harvest or graze treated crop or cut for hay.

POST: Applications may be made from cotyledon to up to 14 days of anticipated bloom.

CLEARFIELD CANOLA
BEYOND and BEYOND XTRA *(imazamox)* Site of Action: 2 **($18.75)**

4 oz Beyond and Beyond Xtra 1L (0.031 lb. ae)

For postemergence application in Clearfield (imazamox-tolerant) varieties. Controls several annual weeds including cocklebur, sunflower, black nightshade, mustard, pigweed, foxtail, wild oat, downy brome, and volunteer cereals (non-Clearfield). Does not control ALS-inhibiting herbicide-resistant weed biotypes (i.e., cocklebur, kochia, sunflower, and waterhemp). Weeds should be less than 3 inches tall for best results. Weed control and crop tolerance have been very good in SDSU tests. Minimum carrier is 10 gpa for ground and 5 gpa for air. Add COC or MSO at 1 – 2% v/v, NIS at 0.25% v/v, plus 28% N at 2.5% v/v or AMS at 12 – 15 lb. per 100-gal solution. Refer to Clearfield sunflowers for rotation intervals.

POST: Apply early postemergence and before bloom stage.

CLEARFIELD or CLEARFIELD PLUS SUNFLOWERS
BEYOND *(imazamox)* Site of Action: 2 **($18.75–28.15)**

4 oz Beyond and Beyond Xtra 1L for Clearfield sunflowers (0.031 lb. ae)
4 – 6 oz Beyond and Beyond Xtra 1L for Clearfield Plus sunflowers (0.031 – 0.047 lb. ae)

Provides a postemergence weed control program for use on Clearfield (imazamox-tolerant) varieties only. The tolerance trait was isolated from wild sunflower and incorporated into commercial seed by conventional breeding techniques. Gives very good to excellent control of several annual broadleaf weeds, including special problem weeds such as cocklebur, mustard, marsh elder, black nightshade, pigweed, purslane, and wild sunflower. Does not control ALS resistant weed biotypes. Labeling includes green and yellow foxtail, “cheatgrass,” wild oat, and volunteer cereals. Most broadleaves should be less than 3 inches tall and grasses 1 to 5 inches tall. Control is most consistent if weeds are small and grasses have not developed expanded tillers. Beyond fits well following soil applied Prowl or other herbicides. Crop tolerance and weed control has been satisfactory in SDSU tests. Beyond can be tank-mixed with Zidua for Clearfield Plus varieties but not for Clearfield varieties.

Rotation intervals are 3 months for alfalfa or wheat; 4 months for rye; 8.5 months for corn; 9 months for sorghum, millet, oats and sunflowers (non-Clearfield); 26 months for canola (non-Clearfield); and 18 months for most other crops. Minimum carrier is 10 gpa for ground or 5 gpa for air. Add NIS at 1 qt/100 gallons spray solution and either 28 % N at 2.5 gallons/100 gallons or AMS at 12 – 15 lbs./100 gallons spray solution. With Clearfield Plus Varieties COC or MSO can be used instead of NIS for better weed control but may increase crop response.

This technology should be managed to reduce risk of developing resistance in wild sunflower. Use crop and herbicide rotations. Avoid fields with heavy sunflower history. Burndown emerged wild sunflower with non-ALS-inhibiting herbicide chemistry before planting. Limit ALS-inhibiting herbicide use to no more than 2 years out of 4 in a field.

POST: Apply at the 2 to 8 leaf crop stage.

EXPRESS SUNFLOWER
EXPRESS or VICTORY *(tribenuron)* Site of Action: 2 **($4.95–9.95)**

0.25 – 0.5 oz Express 50SG (0.008–0.016 lb. ai)
1/6 – 1/3 oz Victory 75DF (0.008–0.016 lb. ai)

For Express-tolerant (ExpressSun) varieties only. Relative to Beyond in Clearfield sunflowers, Express may be slightly more active on some broadleaf weeds but less active on grass weeds. Does not control ALS-inhibiting herbicide-resistant weed biotypes. May be tank mixed with Assure (quizalofop) for grass control. Provides control or suppression of difficult broadleaf weed species, such as cocklebur, Canada thistle, puncturevine, pigweed (redroot and tumble), lambsquarters, marshelder, and others. No significant rotation restrictions as most crops can be planted 45 – 60 days after applications.

Add NIS at 0.5 – 4 pt or COC at 1 gal or MSO at 2 qts per 100 gallons plus AMS at 2 lb./A or UAN at 2 qts/A. If arid conditions COC can be increased to 2 gal and can increase AMS to 4 lb./A or UAN to 4 qts/a. Minimum carrier volume is 5 – 10 gpa (depending on nozzles) for ground application or 2 gpa for aerial applications.

POST: Apply from 2-leaf to pre-bud stage. Best control when weeds are small. Do not make more than two applications and allow 14 days between applications. The maximum rate per year is 2/3 oz Victory or 1 oz Express. Do not apply within 70 days of harvest.

Table 1. Crop Rotation Intervals for Oilseed Crops

Planting intervals are listed in the table below for several herbicides and the oilseed crops in this guide. Herbicides included have restrictions affecting crops to be planted the following season. Restrictions are based on normal use and timing for the product used alone. Refer to product label restrictions.

MINIMUM APPLICATION to PLANTING INTERVAL in MONTHS
(Rotational Crops for the Following Season)

Herbicide	Sunflower	Safflower	Canola	Flax
Accent Q	10-18[3]	10-18[3]	10-18[3]	10-18[3]
Acuron/Acuron Flexi	18	18	18	18
Ally/Ally Extra	22	22	34[1,10]	22
Amber	24[1]	Bio[1]	Bio[1]	Bio[1]
Atrazine	2CS	2CS	2CS	2CS
Autumn Super	18-24[3,7]	18-24[3,7]	18-24[3,7]	18-24[3,7]
Balance Flexx	6	18[2]	18[2]	18[2]
Basis Blend	10	18	10-184	10
Beyond	9, 0[9]	18	18, 0[9]	18
Bicep/Lite II Magnum	2CS	2CS	2CS	2CS
Callisto	10	18	10	0
Capreno	18-24[7]	18[7]	18[7]	18-24[7]
Classic	18	30	18	18
Curtail	10.5-18[6]	10.5[6]	5	5
Facet L	24[1]	24[1]	10	24[1]
Finesse C&F	Bio[1]	Bio[1]	Bio[1]	Bio[1]
FirstRate	30[1]	18	18	18
Flexstar	18	18	18	18
Harness	NCS	2CS	2CS	2CS
Harness Xtra 6L	2CS	2CS	2CS	2CS
Hornet	18	26[1]	26[1]	26[1]
Huskie	9	9	9	9
Laudis	10	181	10	18[1]
Lumax EZ	18	18	18	18
Metribuzin	18	18	18	18
Olympus	Bio[1]	Bio[1]	Bio[1]	Bio[1]
Osprey	1	10	10	10
Permit	18	36	15	36
Powerflex HL	9	9	9	9
Prequel	10	18[2]	18[2]	18
Pruvin	10	18	18	10
Pursuit	18	18	40[1]	26
Python	18	26[1]	26[1]	26[1]
Raptor	9, 0[9]	18	18-26, 0[9]	18
Resicore	10.5[11]	18	18	18
Spartan	0	12	24	0
Steadfast Q	10-18[4]	10-18[3]	10-18[4]	10-18[4]
Stinger	10.5[6]	10.5	0	0
Surestart II	18	26[1]	26[1]	26[1]
Synchrony XP	9-18[3]	30	18	18
Tordon	36[1]	36[1]	36[1]	36[1]
Valor ≤3 oz	2[12]	4	6-12[1,8]	4
WideMatch	10.5[6]	10.5[6]	4	4

Table 1 abbreviation key

NCS = Next cropping season after crop in which herbicide was applied.

NS = Next spring following application. 2CS = Second cropping season after crop in which herbicide was applied.

1 = field bioassay required.

2 = 15” of cumulative precipitation from application to planting of rotational crop.

3 = pH dependent

4 = Extended to 18 months if drought conditions prevail after application and before rotational crop is planted unless sprinkler irrigation has been applied and totals greater than 15” during the growing season.

5 = If applied after June 10 (or if treated crop is destroyed by weather), only corn or grain sorghum can be planted the next year.

6 = 18 months if <15” rainfall or irrigation on soils with < 2% O.M.

7 = ≥ 30” cumulative precipitation

8 = Depends on rate and tillage. See label.

9 = 0 months if Clearfield crop is planted.

10 = 28” of cumulative precipitation.

11 = 18 months for soils with <2% O.M. and rainfall <15 inches for 12 months following application. Only rotate to corn or sorghum next season if applied after June 1.

12 = At least one inch of rainfall/irrigation must occur between application and planting or crop injury may occur.

WEED RESPONSE to HERBICIDES

Weed control percentages are intended as a guide for comparing alternatives. Percentages are estimated based on favorable conditions.

E = Excellent	90-95%	Usually over 90%. Seldom 100%.	Best choice for weed.
G = Good	80-90%	Sometimes under 80%. Seldom over 90%.	Usually, satisfactory.
F = Fair	65-80%	Sometimes under 65%. Seldom over 80%.	Sometimes unsatisfactory. Moderate infestation.
M = Marginal	40-65%	Seldom over 65%. Erratic.	Seldom satisfactory. Light infestations only.
P = Poor		Usually under 40% or no control.	Not recommended.

CROP RESPONSE is based on visual symptoms. Early-season symptoms do not necessarily cause yield losses.

N = None M = moderate VS = very slight

H = high S = slight + = usually, high part of range

HERBICIDE	WEED RESPONSE															CROP RESPONSE			
	Green foxtail	Yellow foxtail	Wild oat	Gen Broadleaf	Redroot pigweed	Smartweed	Lambsquarters	Mustard	Wild buckwheat	Common ragweed	Kochia	Cocklebur	Sunflower	Broadleaf Perennials	Quackgrass	Sunflower	Safflower	Canola	Flax
Trifluralin	E	G+	F+	F	G+	P	G	P	P	P	M+	P	P	P	P	N	N	N	M
Pendimethalin	E	G+	F+	F	G+	P	G	P	P	P	M+	P	P	P	P	N	VS	–	–
Eptam	E	E	G+	M	G	P	F	P	P	P	P	P	P	P	P	S	S	–	–
Sonalan	E	G+	G	F	E	P	G+	P	F	P	M+	P	P	P	P	N	N	N	–
Poast	E	E	G+	P	P	P	P	P	P	P	P	P	P	P	F	N	N	N	N
Assure II	E	E	G+	P	P	P	P	P	P	P	P	P	P	P	F	VS	–	N	N
Select	E	E	G+	P	P	P	P	P	P	P	P	P	P	P	F	N	N	VS	N
Dual II Magnum	G	F+	P	M	G	P	M	P	P	P	M	P	P	P	P	VS	N	–	–
Spartan	M	P	P	G	G	F	G	P	F	P	E	P	P	P	P	S	–	–	S
Liberty[1]	E	G	G+	G+	G	E	G	E	F	G	G	E	E	F	G	–	–	VS	–
MCPA	P	P	P	F+	F	G	E	E	M	M	P	F	F+	F+	P	–	–	–	S
Curtail M	P	P	P	G+	F	G	G	G+	G	G	F	F	E	P	P	–	–	–	S
Bromoxynil	P	P	P	F+	G	G+	G	F	E	G	G	E	E	P	P	–	–	–	M
Glyphosate[1,2]	E	E	E	E	E	G+	E	E	F	E	E	E	E	G	E	–	–	VS	–
Gramoxone	G	G	F	G	G+	F	E	E	F	G	G	G	E	F	F	–	–	–	–
Stinger	P	P	P	M	M	M	M	P	F	G	P	G	G	E	P	–	–	S	–
Beyond[1,2]	G	F	F	G+	E	E	M	E	F	G	P2	E2	E2	M	P	VS	–	VS	–
Express[1,2]	P	P	P	G+	E	M	E	E	F	G	P2	G2	M2	M	P	VS	–	–	–

[1] Herbicide Resistant Crop Only

[2] Populations resistant to Beyond and Express occur in South Dakota.

Foliar Insecticides in Sunflower and Other Oilseeds (Canola, Flax, Safflower)

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Bradley McManus, SDSU Extension IPM Specialist
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Although there are numerous insects that can cause sunflower yield losses In South Dakota, most of these insects are considered occasional or sporadic pests that typically do not require insecticidal management. In 2025, the red sunflower seed weevil caused the most economic damage of all the potential insect pests in South Dakota sunflowers. The Dectes stem borer infestations also remained at a high level, but lodging caused by the larval girdling of this pest is dependent on planting date and harvest date, and to date there is no evidence that foliar insecticides are economical for the management of this pest. Research from the SDSU Extension Field Crop Entomology Lab has demonstrated that earlier planted sunflowers have increased lodging due to Dectes stem borer pressure compared to sunflowers that are planted later. However, SDSU researchers also determined that earlier planted sunflowers have lower red sunflower seed weevil infestations. Decisions for selecting planting date should be based off which pest is more likely to cause economic loss. For all insect pest activity in sunflowers, routine scouting should be used to ensure that no insect pests exceed their associated thresholds. Management thresholds for these pests can be found in An Identification Guide for Sunflower Insect Pests in South Dakota (https://extension.sdstate.edu/identification-guide-sunflower-insect-pests-south-dakota), which is also available in print upon request

A major concern associated with the routine application of insecticides is the development of insecticide resistance in targeted insect populations. To reduce the probability of developing resistance the following recommendations should be followed:

- Scout insect populations and only treat when recommended economic thresholds are exceeded
- If pyrethroid (3A) resistance is suspected, use products from a different class
- If repeated applications are necessary, use insecticides with different modes of action for each application
- Always apply insecticides at the labeled rate
- Do not use premixed or tank mix combinations if insecticide resistance is suspected/documented for one of the classes of insecticides being mixed
- Rotate crops to avoid building up pest populations
- If possible, implement other techniques (planting date, seeding rate, trap cropping) to reduce reliance on insecticides

The insecticides presented in this chapter are restricted use and require a private applicator license or a commercial applicator license with category 1 to purchase and use. General use products that do not require licensing are marked with an asterisk (*). Follow insecticide labels carefully. Be sure to always wear the proper personal protective equipment when working with insecticides to reduce personal exposure. Remember, the label is law and any deviations from it are considered unlawful. Do not apply insecticides for insects that are not presented on the label. In addition, for any labels with the bee symbol and even those without, try to apply insecticides when pollinators are not actively foraging or when crops are not blooming.

When choosing an insecticide, refer to labels for precise rates based on observed pest insects. Always follow the labeled recommended rates for a crop and insect pest. Do not go above or below the labeled rates as they are scientifically determined to provide optimum knockdown of the insect pest population.

In South Dakota, there are documented populations of red sunflower seed weevils that are resistant to pyrethroid insecticides throughout the sunflower production areas. For this reason, SDSU Extension Entomologists DO NOT recommend the use of products containing the active ingredients lambda-cyhalothrin, esfenvalerate, zeta-cypermethrin, deltamethrin, or beta-cyfluthrin alone or in a mixture with other active ingredients. Every year, SDSU receives numerous reports of red sunflower seed weevil management failures associated with the use of products containing these active ingredients. These products should also not be tank mixed with other labeled products to reduce the application rate of the primary product. Research at SDSU did observe an approximate 10% increase in the effectiveness of esfenvalerate when combined with a piperonyl butoxide synergist (Exponent, PBO-8) in a laboratory setting, but this may still result in above threshold weevil populations in the field.

The products in this chapter are presented as follows:

Mode of action group number (chemical class)
***Active ingredient(s)*:**
Trade Name(s):

Additional resources regarding insecticide safety can be found at:

- IRAC Insecticide Resistance Action Committee (http://www.irac-online.org/modes-of-action/)
- EPA United States Environmental Protection Agency (https://www.epa.gov/pesticide-worker-safety)
- South Dakota Department of Agriculture and Natural Resources (https://danr.sd.gov/Agriculture/default.aspx)
- Kelley Solutions (https://www.kellysolutions.com/SD/searchbychem.asp)

Check list of insects managed by each foliar insecticide for sunflower, canola, flax and safflower*

Mode of Action Group Number(s)	Active Ingredient	Red sunflower seed weevil	Grasshopper	Banded sunflower moth	Sunflower moth	Sunflower bud moth	Darksided cutworm	Dingy cutworm	Redbacked cutworm	Beet armyworms	Bertha armyworm	Diamondback moth	Thistle caterpillars	Gray sunflower seed weevil	Sunflower stem weevil	Palestriped flea beetle	Potato flea beetle	Sunflower beetle	Dectes stem borer	Tarnished plant bug	Cabbage aphid
1A	**Carbaryl**	-	-	-	+	-	+	+	+	+	+	-	-	-	+	-	-	+	-	-	-
1B	**Malathion**	+	+	+	+	+	+	+	+	+	-	-	-	-	-	+	-	-	-	-	-
3A	**Beta-cyfluthrin**	+	+	+	+	+	+	+	+	+	-	-	-	-	-	+	-	-	-	-	-
3A	**Cyfluthrin**	+	+	-	+	+	+	+	+	-	-	-	-	+	+	+	-	+	-	-	-
3A	**Deltamethrin**	+	+	+	+	-	+	+	+	+	+	-	-	+	+	-	+	+	-	+	-
3A	**Esfenvalerate**	+	+	+	+	-	+	+	+	+	-	-	-	+	+	-	-	-	-	-	-
3A	**Gamma-cyhalothrin**	+	+	+	+	-	+	+	+	-	+	+	+	+	+	-	-	+	-	-	-
3A	**Lambda-cyhalothrin**	+	+	+	+	-	+	+	+	+	+	+	+	+	+	-	-	+	-	+	+
3A	**Zeta-cypermethrin**	+	+	+	+	-	+	+	+	-	+	+	+	+	+	-	-	+	+	-	-
3A + 28	**Lambda-cyhalothrin + Chlorantraniliprole**	+	+	+	+	-	+	+	+	+	+	+	+	+	-	+	+	-	-	+	+
11A	***Bacillus thuringienses***	-	-	+	+	-	-	-	-	+	+	-	-	-	-	-	-	-	-	-	-
28	**Chlorantraniliprole**	-	+	+	+	-	-	-	-	-	-	+	-	-	-	-	-	-	-	-	-
28	**Cyantraniliprole**	-	+	+	+	-	-	-	-	-	-	+	-	-	-	-	-	-	-	-	-

"+" = labeled for management in sunflower and other oilseeds*
"-" = not labeled for management in sunflower and other oilseeds*
*Check product listing for labeled crops

Check list of insects managed by each soil-applied insecticide for sunflower

Mode of Action Group Number	Active Ingredient	Cutworms	White Grubs	Seedcorn maggot	Wireworm
3A	**Chlorpyrifos**	+	+	+	+
3A	**Zeta-cypermethrin**	+	+	-	+

"+" = labeled for management in sunflower
"-" = not labeled for management in sunflower

Insecticide Modes of Action

Mode of Action Group Number	Insecticide Class
1A	Carbamates
1B	Organophosphates
3A	Pyrethroids, pyrethrins
11A	*Bacillus thurengiensis*
28	Diamides

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Foliar Insecticides for Sunflower and other Oilseeds

Soil-Applied Insecticides for Sunflower

Foliar Insecticides for Sunflower and other Oilseeds

Mode of Action 1A (Carbamates)

Active Ingredient: Carbaryl

Trade Names: Carbaryl 4L, Drexel Carbaryl 4L, Sevin XLR Plus

REI: 12 hours

Sunflower PHI: 60 days

Flax PHI: 42 days

Targeted Insects for Sunflower: Dark sided cutworm caterpillars, dingy cutworm caterpillars, red backed cutworm caterpillars, fall armyworm caterpillars, sunflower moth caterpillars, sunflower beetle larvae and adults, and sunflower stem weevil adults.

Targeted Insects for Flax: Bertha armyworm caterpillars.

Restrictions: Do not apply more than 3 qt/A in a single season. Do not apply this product when target crops or weeds are in bloom.

Mode of Action 1B (Organophosphates) Special Local Needs Registration 24c until 2030

Active Ingredient: Malathion

Trade Names: Fyfanon Malathion Insecticide, Malathion 57 EC, Fyfanon 57% EC, Malathion 5 Insecticide

REI: 12 hours

Minimum Retreatment Interval: 5 days

Sunflower PHI: 7 days

Targeted Insects for Sunflower: Red sunflower seed weevil

Restrictions: Applications only valid from July 15-August 31 each year. Do not apply more than 3.2 pints per acre per year in a single field. Do not apply this product when target crops or weeds are in bloom. Apply in early morning or late evening.

Mode of Action 3A (Pyrethroids)

Active Ingredient: Beta-cyfluthrin

Trade Names: Baythroid XL, Cryptoid XL, Sultrus

REI: 12 hours

PHI: 30 days

Targeted Insects for Sunflower: Dark sided cutworm caterpillars, dingy cutworm caterpillars, red backed cutworm caterpillars, banded sunflower moth caterpillars, sunflower bud moth caterpillars, sunflower moth caterpillars, grasshopper nymphs and adults, gray sunflower seed weevil adults, red sunflower seed weevil adults, and pale striped flea beetle adults.

Restrictions: Do not apply more than 0.022 lb. ai/A per 7-day interval. Do not apply more than 0.066 lb. ai/A in a single season. Do not apply using an ultra-low volume (ULV) spray.

Active Ingredient: Cyfluthrin

Trade Names: Tombstone, Tombstone Helios

REI: 12 hours

PHI: 30 days

Targeted Insects for Sunflower: Banded sunflower moth caterpillars, dark sided cutworm caterpillars, dingy cutworm caterpillars, red backed cutworm caterpillars, sunflower bud moth caterpillars, sunflower moth caterpillars, grasshopper nymphs and adults, gray sunflower seed weevil adults, red sunflower seed weevil adults, pale striped flea beetle adults, sunflower stem weevil adults, and sunflower beetle larvae and adults.

Restrictions: Do not reapply within seven days of application. Do not apply more than 0.044 lb. ai/A in a single application. Do not apply more than 0.131 lb. ai/A in a single season. Do not apply as an ultra-low volume (ULV) spray.

Active Ingredient: Deltamethrin

Trade Names: Delta Gold 1.5EC, Delta Gold 100

REI: 12 hours

Sunflower PHI: 21 days

Canola PHI: 21 days for Delta Gold 1.5EC, 7 days for Delta Gold 100

Targeted Insects for Sunflower: Banded sunflower moth caterpillars, dark sided cutworm caterpillars, dingy cutworm caterpillars, red backed cutworm caterpillars, sunflower moth caterpillars, gray sunflower seed weevil adults, red sunflower seed weevil adults, flea beetle adults, sunflower stem weevil adults, and sunflower beetle larvae and adults.

Targeted Insects for Canola: Bertha armyworm caterpillars, clover cutworm caterpillars, diamondback moth caterpillars, flea beetle adults, grasshopper nymphs and adults, and lygus bug nymphs and adults.

Restrictions: Do not apply more than 0.045 lb. ai/A in a single season. Do not graze or feed treated foliage to livestock. Do not apply this product as an ultra-low volume (ULV) spray.

Active Ingredient: Esfenvalerate

Trade Names: Asana XL, S-FenvaloStar

REI: 12 hours

PHI: 38 days

Targeted Insects for Sunflower: Banded sunflower moth caterpillars, sunflower moth caterpillars, cutworm species caterpillars, beet armyworm caterpillars, grasshopper nymphs and adults, sunflower beetle adults, red sunflower seed weevil adults, gray sunflower seed weevil adults, and sunflower stem weevil adults.

Restrictions: Do not apply more than 0.2 lb. ai/A in a single season. Do not apply more than 0.05 lb. ai/A per application.

Active Ingredient: Gamma-cyhalothrin

Trade Names: Declare, Proaxis

REI: 24 hours

Sunflower PHI: 45 days
Canola PHI: 7 days

Targeted Insects for Sunflower: Banded sunflower moth caterpillars, dark sided cutworm caterpillars, dingy cutworm caterpillars, red backed cutworm caterpillars, fall armyworm caterpillars, sunflower moth caterpillars, thistle caterpillars, grasshopper nymphs and adults, gray sunflower seed weevil adults, red sunflower seed weevil adults, sunflower stem weevil adults, and sunflower beetle larvae and adults.

Targeted Insects for Canola: Bertha armyworm caterpillars, army cutworm caterpillars, diamondback moth caterpillars, cabbage aphid nymphs and adults, grasshopper nymphs and adults, lygus bug nymphs and adults, and flea beetle adults.

Restrictions: Do not apply more than 0.045 lb. ai/A after bloom initiation. Do not apply more than 0.06 lb. ai/A per season. Do not apply as an ultra-low volume (ULV) spray.

Active Ingredient: Lambda-cyhalothrin

Trade Names: Cavalry II, Crusader 1EC, Crusader 2ME, Drexel L-C Insecticide, Grizzly Too, Kendo, Kendo 22.8 CS, Lambda 1EC, Lambda Select, Lambda T, Lambda T-2, Lambda-Cy AG, Lambda-Cy EC, LambdaStar 1CS, LambdaStar, LambdaStar Plus, Lambda-Cyhalothrin 1EC, Lamcap II, Paradigm VC, Province II, Ravage, Ravage II, Roundhouse 1 EC, Serpent 1 EC, Silencer, Silencer VXN, Warrior II

REI: 24 hours

Sunflower PHI: 45 days
Canola PHI: 7 days

Targeted Insects for Sunflower: Banded sunflower moth caterpillars, dark sided cutworm caterpillars, dingy cutworm caterpillars, red backed cutworm caterpillars, fall armyworm caterpillars, sunflower moth caterpillars, thistle caterpillars, gray sunflower seed weevil adults, red sunflower seed weevil adults, sunflower stem weevil adults, and sunflower beetle larvae and adults.

Targeted Insects for Canola: Bertha armyworm caterpillars, cutworm species caterpillars, diamondback moth caterpillars, cabbage aphid nymphs and adults, grasshopper nymphs and adults, lygus bug nymphs and adults, and adult flea beetles.

Restrictions: Do not apply more than 0.09 lb. ai/A after bloom initiation. Do not apply more than 0.12 lb. ai/A per season. Do not apply as an ultra-low volume (ULV) spray. Do not reapply within 5 days.

Active Ingredient: Zeta-cypermethrin

Trade Names: Cortes Maxx, Mustang, Mustang Maxx

REI: 12 hours

Sunflower PHI: 30 days
Canola and Flax PHI: 7 days
Safflower PHI: 14 days

Targeted Insects for Sunflower: At plant insecticide: Cutworm species caterpillars, white grub larvae, and wireworm larvae.

Foliar insecticide: Banded sunflower moth caterpillars, dark sided cutworm caterpillars, dingy cutworm caterpillars, red backed cutworm caterpillars, fall armyworm caterpillars, sunflower moth caterpillars, thistle caterpillars, grasshopper nymphs and adults, Dectes stem borer adults, gray sunflower seed weevil adults, red sunflower seed weevil adults, sunflower stem weevil adults, and sunflower beetle larvae and adults.

Targeted Insects for Canola: Bertha armyworm caterpillars, cutworm species caterpillars, diamondback moth caterpillars, cabbage aphid nymphs and adults, green peach aphid nymphs and adults, turnip aphid nymphs and adults, grasshopper nymphs and adults, lygus bug nymphs and adults, and flea beetle adults.

Targeted Insects for Flax: Army cutworm caterpillars, pale western cutworm caterpillars, redbacked cutworm caterpillars, bertha armyworm caterpillars, and grasshopper nymphs and adults.

Targeted Insects for Safflower: Cutworm species caterpillars.

Restrictions: Do not apply more than 0.125 lb. ai/A in a single season. Do not make more than five applications in a single season. Do not feed treated foliage to livestock. Avoid applications when bees are actively foraging.

Mode of Action 3A (Pyrethroids) and 28 (Diamides)

Active Ingredient: Lambda-cyhalothrin + Chlorantraniliprole

Trade Name: Besiege

REI: 24 hours

PHI: 45 day
Canola PHI: 21 day

Targeted Insects for Sunflower: Dark sided cutworm caterpillars, dingy cutworm caterpillars, red backed cutworm caterpillars, banded sunflower moth caterpillars, fall armyworm caterpillars, sunflower moth caterpillars, and thistle caterpillars, sunflower beetle larvae and adults, gray sunflower seed weevil adults, and red sunflower seed weevil adults.

Targeted Insects for Canola: Cutworm species caterpillars, army cutworm caterpillars, armyworm species caterpillars, diamondback moth caterpillars, cabbage aphid nymphs and adults, grasshopper nymphs and adults, adult flea beetles, and lygus bug nymphs and adults.

Restrictions: Do not apply more than 31.0 fl oz/A of Besiege in a single season. Do not apply more than 28 fl oz/A after bloom initiation. Do not reapply within 5 days.

Mode of Action 11A (*Bacillus thuringiensis*)

Active Ingredient: *Bacillus thuringiensis*, subsp. *aizawai* Strain ABTS-1857

Trade Name: XenTari

REI: 4 hours **PHI:** none

Targeted Insects for Sunflower: Head moth and armyworms.

Active Ingredient: *Bacillus thuringiensis*, subsp. *aizawai* Strain GC-91

Trade Name: Agree WG

REI: 4 hours **PHI:** none

Targeted Insects for Sunflower: Armyworms.

Active Ingredient: *Bacillus thuringiensis*, subsp. *kurstaki*

Trade Name: Crymax, DiPel ES

REI: 4 hours **PHI:** none

Targeted Insects for Sunflower: Sunflower moth caterpillars and banded sunflower moth caterpillars.

Mode of Action 28 (Diamides)

Active Ingredient: Chlorantraniliprole

Trade Names: Coragen, Prevathon, Shenzi 400SC, Vantacor

REI: 4 hours **PHI:** 1 days

Targeted Insects for Sunflower: Banded sunflower moth caterpillar, diamondback moth caterpillar, sunflower moth caterpillars, and grasshopper nymphs and adults.

Restrictions: Do make more than four applications in a single season. Do not use more than 0.2 lb. ai/A in a single season. Do not reapply within 5 days.

Active Ingredient: Cyantraniliprole

Trade Names: Exirel, Fortenza

REI: 12 hours **PHI:** 7 days

Targeted Insects for Sunflower: Banded sunflower moth caterpillar, diamondback moth caterpillar, sunflower moth caterpillars, crucifer flea beetle adults and grasshopper nymphs and adults.

Restrictions: Do not apply more than 0.40 lb. ai/A of chlorantraniliprole products to a crop in a single season. Do not reapply within 7 days.

Soil-Applied Insecticides for Sunflower

Mode of Action 3A (Pyrethroids)

Active Ingredient: Bifenthrin

Trade Names: Capture 3RIVE 3D *Liquid insecticide for use in a 3RIVE 3D system only, Capture LFR

REI: 12 hours **PHI:** NA

Targeted Insects for Sunflower: Cutworm caterpillars, seedcorn maggot, white grubs, and wireworms.

Restrictions: Do not make more than one application per year. Do not apply more than 0.2 lb. ai/A or 16 fl oz/A of products per year.

Active Ingredient: Zeta-cypermethrin

Trade Names: Cortes Maxx, Mustang, Mustang Maxx

REI: 12 hours **PHI:** 30 days

Targeted Insects: Cutworm caterpillars, white grub larvae, and wireworm larvae.

Restrictions: Do not apply more than 21.5 fl oz/A in a season.

Fungicide and Insecticide Seed Treatments in Sunflower and Other Oilseeds (Canola, Flax, Safflower)

Madalyn Shires, Assistant Professor and SDSU Extension Plant Pathologist
Connie Strunk, SDSU Extension Plant Pathology Field Specialist
Adam J. Varenhorst, Associate Professor and SDSU Extension Field Crop Entomologist
Patrick Wagner, SDSU Extension Entomology Field Specialist
Bradley McManus, SDSU Extension IPM Specialist
Philip Rozeboom, SDSU Extension IPM Coordinator

Seed treatments are useful tools in promoting plant stand establishment and seedling vigor in sunflower and other oilseed crops. Seed treatments can help preserve yield potential and prevent quality losses in grain by preventing the development of seed and soil-borne diseases.

In general, fungicidal seed treatments are used for three primary reasons:

1. To control soil-borne fungal disease agents that may cause seed rots or seedling blights in many crops, as well as root rot complex or downy mildews.
2. To control diseases caused by seed surface-borne fungal pathogens.
3. To manage diseases caused by seed-borne fungi.

In general, insecticidal seed treatments are used to manage early season feeding caused by the following insects:

1. Flea beetles
2. Seedcorn maggots
3. Sunflower beetles
4. Aphids
5. Wireworms

To determine if seed treatment is necessary for your field, consider the history of diseases and insect pests in the field, soil conditions at planting (e.g., wet and cool soils, no-till fields, non-rotated fields), if the crop is for grain or seed production, susceptibility of the cultivar, and target plant population (low planting population may benefit from seed treatment).

Proper identification of disease agents and insect pests is also important. SDSU state specialists, Extension Field Specialists and the Plant Diagnostic Clinic can assist producers in identifying plant health problems affecting stand establishment throughout the growing season. It is important to note that most seed treatment products do not control all types of fungal pathogens or insect pests. Effectiveness of control will vary with seed treatment product, rate, environmental conditions, and pests present.

Integrated Pest Management
Disease management in agricultural crops requires a multi-faceted approach as part of an integrated pest management (IPM) program. Effective components of an integrated plant disease management program include the following:

- Crop rotation, including rotation to non-host crops to reduce pathogen load.
- Residue and volunteer plants management for reduction of residue-borne and overwintering pathogens.
- Use of high quality, disease-free seed to prevent the spread of seed-borne diseases.
- Proper variety selection for host resistance and adaptation to the growing region.
- Proper plant health management. Healthy plants are more able to resist or tolerate the development of plant diseases.
- Judicious use of plant protectant products such as fungicides.

Classification of Fungicidal Seed Treatments
Fungicidal seed treatments can be classified based on movement of the seed treatment product in relation to the seed. Fungicides used as protectants (contacts) are effective only on the seed surface. These products generally have a relatively short residual.

Protectant fungicides such as thiram or fludioxonil help control most types of soil-borne pathogens, with the exception of the root rotting organisms. Systemic seed treatment fungicides are absorbed into the emerging seedling and inhibit or kill the fungus inside host plant tissues. Common systemic fungicides used for seed treatment include: azoxystrobin, mefenoxam, and metalaxyl.

Not all fungicides are available as seed treatments for every crop, and not all fungicides have activity against the same range of organisms. Refer to the specific crop-pest combinations listed in the text for product-use recommendations. Always read and follow label directions.

Proper Application and Use Precautions
Seed treatment products vary in formulation type, packaging, and use requirements. Products may be dry or liquid and in concentrate or ready-to-use formulations. While many seed treatments may be applied on-farm, several products are limited to use only by commercial applicators in closed application systems. Use caution when handling or working with seed treatment products. Seed treatments can be highly poisonous, so proper handling precautions must be taken.

Producers and applicators must strictly adhere to all label directions regarding safe handling, mixing, storage, and disposal. Using personal protection equipment (PPE) is recommended even if not specifically required by the label. Good disease control depends on uniform fungicide coverage of the seed. Note that this can be more difficult to accomplish in planter-applied situations. Always read and follow label directions. Do not use treated seed for food or feed. Always dispose of pesticide containers properly.

The products in this chapter are presented as follows:

Trade name(s) *(Chemical common name)* Mode of action: Group code (chemical class).

Additional resources regarding insecticide safety can be found at:

- IRAC Insecticide Resistance Action Committee (http://www.irac-online.org/modes-of-action/)
- EPA United States Environmental Protection Agency (https://www.epa.gov/pesticide-worker-safety)
- South Dakota Department of Agriculture and Natural Resources (https://danr.sd.gov/Agriculture/default.aspx)
- Kelley Solutions (https://www.kellysolutions.com/SD/searchbychem.asp)

Product Table of Contents

Sunflower Fungicides

Canola Fungicides

Flax Fungicides

Safflower Fungicides

Sunflower and Canola Insecticide Seed Treatments

Fungicide FRAC Codes and Group Names

FRAC Code	Group Name
3	Demethylation inhibitors (DMI)
4	Phenylamides (PA)
7	Succinate dehydrogenase inhibitors (SDHI)
11	Quinone outside inhibitors (QoI)
12	Phenylpyrroles (PP)
M3	Dithiocarbamates
M4	Phthalimides

Insecticide Mode of Action

Mode of Action Group Number	Insecticide Class
4A	Neonicotinoids

Check list of diseases controlled by each fungicide seed treatment

Product Name(s)	Sunflower		Canola		Flax			Safflower	
	Systemic downy mildew	Seedling rot	Seed and seedling rots	Seed- and air-borne black leg	Seed and seedling rot	Seedling blight caused by Fusarium spp	Seedling blight caused by Rhizoctonia solani	Seed and seedling rots	Seedborne rust
42-S Thiram, Signet 480 FS	-	+	+	-	+	-	+	+	-
Thiram 480 DP	-	-	-	-	-	-	-	+	-
Acquire, Allegiance FL	+	-	+	-	-	-	-	-	-
Belmont 2.7 FS, Dyna-Shield Metalaxyl, Dyna-Shield Metalaxyl 318 FS, Metalaxyl 265 ST, Metalaxyl 4.0 ST, Sebring 318 FS, Sebring 480 FS	+	-	-	-	-	-	-	-	-
Apron XL	+	-	-	-	-	-	-	-	-
Bion 500FS	+	-	-	-	-	-	-	-	-
Manzate Max, Manzate Pro-Stick	-	-	-	-	+	-	-	-	+
Dithane M45, Dithane F-45 Rainshield, Penncozeb 75DF, Penncozeb 80WP	-	-	-	-	+	+	+	-	+
Dynasty	+	+	+	+	-	-	-	-	-
Evergol Prime	-	+	-	-	-	-	-	-	-
Luminesa, Plenaris 200FS	+	-	-	-	-	-	-	-	-
Maxim 4FS, Spirato 480 FS, Dyna-Shield Fludioxonil, Fludioxonil 4L	-	+	-	-	+	+	+	+	-
Maxim XL	+	+	-	-	-	-	-	-	-
Rancona 3.8FS	-	+	+	-	-	-	-	-	-
Saltro	-	-	-	+	-	-	-	-	-
Stamina	+	+	+	+	-	-	-	-	-
Coronet	-	-	+	+	-	-	-	-	-
Vibrance	+	-	+	-	-	-	-	-	-
Vitavax-34	-	+	-	-	-	-	-	+	-

"+" = product provides control
"-" = product does not provide control

Check list of insects managed by each insecticide seed treatment.

Product Name(s)	Sunflower						Canola		
	Flea beetles	Seedcorn maggots	Sunflower beetle	White grubs	Wireworms	Aphids	Aphids	Flea beetles	Wireworms
Adage, Cruiser 5FS, Elliptica, Legend 5L ST, Phalanx	+	-	+	-	+	-	-	-	-
Attendant 600 FS, Axcess, Dyna-Shield Imidacloprid 5, Gaucho 480, Gaucho 600, Nitro Shield IV, Resonate 480 ST, Resonate 600 ST, Senator 600 FS, STartUP IMIDA	+	+	-	+	+	+	-	+	+
Attendant 480 FS, Sharda Imidacloprid 5SC	-	-	-	-	-	-	+	+	+
Poncho 600	-	-	-	-	-	-	-	+	+

"+" = product provides control
"-" = product does not provide control

Sunflower Fungicide Seed Treatments

42-S THIRAM, SIGNET 480 FS *(thiram)* Mode of action: M3 (dithiocarbamates)

Application Rate: 2 fl oz/bu

REI: 24 hours

Targeted diseases: Seed and seedling rots.

Acquire, Allegiance FL, Belmont 2.7 FS, Dyna-Shield Metalaxyl, Dyna-Shield Metalaxyl 318 FS, Metalaxyl 265 ST, Metalaxyl 4.0 ST, Sebring 318 FS, Sebring 480 FS *(metalaxyl)* Mode of Action: 4 (phenylamides)

Application Rate Acquire, Metalaxyl 265 ST, Belmont 2.7 FS, Sebring 318 FS, Dyna-Shield Metalaxyl 318 FS: 1.5 – 9 fl oz/cwt
Application Rate Allegiance FL Dry: 4 oz/cwt; Allegiance FL: 1.5 – 3 fl oz/cwt
Application Rate Dyna-Shield Metalaxyl: 0.9 – 3 fl oz/cwt
Application Rate Metalaxyl 4.0 ST, Sebring 480 FS: 1 – 6 fl oz/cwt

REI: 24 hours

Targeted diseases: Systemic downy mildew.

APRON XL *(mefenoxam)* Mode of Action: 4 (phenylamides)

Application Rate: 1.28 – 4.45 fl oz/cwt

REI: 48 hours

Targeted diseases: Systemic downy mildew.

BION 500FS *(acibenzola-S-mehtyl)* Mode of Action: 42

Application Rate: 0.63–0.88 fl oz/cwt

REI: 0 hours

Targeted diseases: Systemic downy mildew.

DYNASTY *(azoxystrobin)* Mode of Action: 11 (QoI)

Application Rate: 3.75 – 15 fl oz/cwt

REI: 4 hours

Targeted diseases: Damping Off and Downy Mildew

EVERGOL PRIME *(penflufen)* Mode of action: 7 (SDHI)

Application Rate: 0.32 – 0.96 fl oz/cwt

REI: 12 hours

Targeted diseases: Seed rot and seedling blight caused by Rhizoctonia.

LUMISENA, PLENARIS 200FS *(Oxathiapiprolin)* Mode of Action: Lumisena: U15 (Unknown), Plenaris: 49 (OSBPI)

Application Rate: 1.033 – 2.066 fl oz/cwt

REI: 0 hours

Targeted diseases: Downy mildew.

MAXIM 4FS, SPIRATO 480 FS, DYNA-SHIELD FLUDIOXONIL, FLUDIOXONIL 4L *(fludioxonil)* Mode of Action: 12 (phenylpyrroles)

Application Rate: 0.08 – 0.16 fl oz/cwt

REI: 12 hours

Targeted diseases: Seed and seedling rots. If grazing after use of Spirato 480 FS or Fludioxonil 4L, 30 Day pre-harvest interval.

MAXIM XL *(fludioxonil + mefenoxam)* Mode of Action: 12 (phenylpyrroles) and 4 (phenylamides)

Application Rate: 0.167 – 0.334 fl oz/cwt (Use higher rate if pythium pressure is expected)

REI: 48 hours

Targeted diseases: Seed and seedling rots, Systemic downy mildew. To be used with additional Apron XL (See label for instructions).

RANCONA 3.8FS *(ipconazole)* Mode of action: 3 (demethylation inhibitors)

Application Rate: 0.051 – 0.085 fl oz/cwt

REI: 12 hours

Targeted diseases: Fusarium and Rhizoctonia Seedling Blight/Damping Off; Aspergillus, Fusarium, Rhizoctonia, Penicillium Seed Rot

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STAMINA *(pyraclostrobin)* Mode of Action: 11 (QoI)

Application Rate: 0.8 – 2.3 fl oz/cwt (Use higher rate when disease pressure is expected to be high)

REI: 12 hours

Targeted diseases: Seed and seedling diseases for Rhizoctonia, Fusarium, and Pythium.

Canola Fungicide Seed Treatments

42-S THIRAM, SIGNET 480 FS *(thiram)* Mode of action: M3 (dithiocarbamates)

Application Rate: 6.4 fl oz/cwt

REI: 24 hours

Targeted diseases: Seed/seedling rots, alternaria, and phoma

ALLEGIANCE FL, ACQUIRE *(metalaxyl)* Mode of Action: 4 (phenylamides)

Application Rate Allegiance FL: 0.25 – 0.5 fl oz/cwt
Application Rate Acquire: 0.25 – 1.7 fl oz/cwt

REI: 24 hours

Targeted diseases: Seed and seedling rots caused by Pythium

DYNASTY *(azoxystrobin)* Mode of action: 11 (QoI)

Application Rate: 0.10 – 3.75 fl oz/cwt

REI: 4 hours

Targeted diseases: Alternaria Seedling Blight, Rhizoctonia Seedling Disease, Seed-borne blackleg, Damping off.

SALTRO *(pydiflumetofen)* Mode of action: 7 (SDHI)

Application Rate: 1.23 fl oz/cwt

REI: 12 hours

Targeted diseases: seed- and air-borne black lag

STAMINA, CORONET *(pyraclostrobin)* Mode of action: 11 (QoI); Coronet 11 and 7 (SDHI)

Application Rate Stamina: 1.5 – 3.1 fl oz/cwt
Application Rate Coronet: 3.1 – 6.2 fl oz/cwt

REI: 12 hours

Targeted diseases: Stamina- Fusarium Seed/Seedling Disease, Pythium Seed/Seedling Disease, Rhizoctonia solani seed/seedlings disease. Coronet- Cladosporium, Damping off, Decay, Seed/Seedling Disease, Penicillium, Phoma lingam, Rhizoctonia solani.

VIBRANCE *(sedaxane)* Mode of action: 7 (SDHI)

Application Rate: 0.08 – 0.16 fl oz/cwt (Max of 2 applications/season))

REI: 12 hours

Targeted diseases: Rhizoctonia solani seedling blight and damping off, Seed Decay

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Flax Fungicide Seed Treatments

42-S THIRAM, SIGNET 480 FS *(thiram)* Mode of action: M3 (dithiocarbamates)

Application Rate: 3 fl oz/bu

REI: 24 hours

Targeted diseases: Seed and seedling rots.

MANZATE MAX, MANZATE PRO-STICK *(mancozeb + surfactant)* Mode of action: M3 (dithiocarbamates)

Application Rate Manzate Max: 5.7 – 11.3 fl oz/cwt
Application Rate Manzate Pro-Stick: 3.6 – 7.1 oz/cwt

REI: 24 hours

Targeted diseases: Damping-off, seed and seedling rots.

DITHANE M45, DITHANE F-45 RAINSHIELD, PENNCOZEB 75DF, PENNCOZEB 80WP *(mancozeb)* Mode of action: M3 (dithiocarbamates)

Application Rate Dithane M-45, Penncozeb 80 WP: 3.6 – 7.1 oz/cwt
Application Rate Dithane F-45 Rainshield: 5.7 – 11.3 fl oz/cwt
Application Rate Penncozeb 75DF: 3.8 – 7.6 oz/cwt

REI: 24 hours

Targeted diseases: Seed and seedling rots, blights, and damping off.

MAXIM 4FS, SPIRATO 480 FS, DYNA-SHIELD FLUDIOXONIL *(fludioxonil)* Mode of Action: 12 (phenylpyrroles)

Application Rate: 0.08 – 0.16 fl oz/cwt

REI: 12 hours; Spirato 480 FS has a 30-day preharvest interval.

Targeted diseases: Seed and seedling rots, Fusarium and Rhizotonia root rots.

SALTRO *(pydiflumetofen)* Mode of action: 7 (SDHI)

Application Rate: 1.23 fl oz/cwt

REI: 12 hours

Targeted diseases: seed- and air-borne blackleg

Safflower Fungicide Seed Treatments

42-S THIRAM, THIRAM 480 DP, SIGNET 480 FS *(thiram)* Mode of action: M3 (dithiocarbamates)

Application Rate 42-S Thiram, Signet 480 FS: 2 fl oz/bu
Application Rate Thiram 480 DP: 8.3 fl oz/bu

REI: 24 hours

Targeted diseases: Seed and seedling rots.

MANZATE MAX, MANZATE PRO-STICK *(mancozeb + surfactant)* Mode of action: M3 (dithiocarbamates)

Application Rate Manzate Max: 3.2 fl oz/cwt
Application Rate Manzate Pro-Stick: 2 oz/cwt

REI: 24 hours

Targeted diseases: Seed-borne rust.

DITHANE M45, PENNCOZEB 75DF, PENNCOZEB 80WP *(mancozeb)* Mode of action: M3 (dithiocarbamates)

Application Rate Dithane M45, Penncozeb 80 WP: 2 oz/cwt
Application Rate Penncozeb 75 DF: 2.1 fl oz/cwt

REI: 24 hours

Targeted diseases: Seed-borne rust.

MAXIM 4FS, SPIRATO 480 FS, DYNA-SHIELD FLUDIOXONIL *(fludioxonil)* Mode of Action: 12 (phenylpyrroles)

Application Rate: 0.08 – 0.16 fl oz/cwt

REI: 12 hours; 30-day pre-harvest interval for Spirato 480 FS if used for grazing

Targeted diseases: Seed and seedling rots.

VITAVAX-34 *(carboxin)* Mode of Action: 7 (SDHI)

Application Rate: 2 fl oz/cwt

REI: 12 hours; 6 week harvest interval if used for grazing

Targeted diseases: Seed and seedling rots, Rhizoctonia solani

Sunflower and Canola Insecticide Seed Treatments

Adage, Cruiser 5FS, Elliptica, Legend 5L ST, Phalanx *(thiamethoxam)* Mode of Action: 4A (neonicotinoids)

Sunflower Application Rate: 0.25 – 0.50 mg ai/seed or 10.24 – 32 fl oz/cwt

REI: 12 hours

Sunflower targeted insects: Flea beetle adults, sunflower beetle adults, and wireworm larvae.

Restrictions: Do not use a rate that will result in more than 0.14 lb. thiamethoxam per acre per season.

Attendant 480 FS, Attendant 600 FS, Dyna-Shield Imidacloprid 5, Gaucho 480, Gaucho 600, Nitro Shield IV, Resonate 480 ST, Resonate 600 ST, Revize Imida ST, Senator 600 FS, Sharda Imidacloprid 5SC, STartUP Imida *(imidacloprid)* Mode of Action: 4A (neonicotinoids)

Sunflower Application Rate (excluding Attendant 480 FS, Sharda Imidacloprid 5SC): 0.25 – 0.50 mg ai/seed or 10.24 – 32 fl oz/cwt
Canola Application Rate (excluding Gaucho 480): 10.24 – 32 fl oz/cwtt
Canola Application Rate for Gaucho 480: 6.4 – 16 fl oz/50 lb. seed bag of canola

REI: 12 hours

Sunflower targeted insects: Flea beetle adults, seed corn maggot larvae, white grub larvae (excluding Revise IMIDA ST), and wireworm larvae.

Canola targeted insects: Aphids, flea beetle adults, and wireworm larvae.

Poncho 600 *(clothianidin)* Mode of Action: 4A (neonicotinoids)

Canola Application Rate: 3.84 – 10.23 fl oz/cwt

REI: 12 hours

Canola targeted insects: Flea beetle adults and wireworm larvae.

Foliar Fungicides in Oilseed Crops (Canola, Flax, Safflower, Sunflower)

Madalyn Shires, Assistant Professor and SDSU Extension Plant Pathologist
Connie Strunk, SDSU Extension Plant Pathology Field Specialist

Foliar fungicides can be beneficial in controlling a few fungal diseases which develop on oilseed crops. These diseases include Pasmo/Septoria in flax; Alternaria black spot, black-leg, and white mold on canola; sunflower rust, Alternaria leaf spot, and white mold on sunflower; and Alternaria leaf spot for safflower.

For effective and sustainable disease management, fungicides are most effective as part of an integrated disease management strategy. Foliar fungicides alone are not the most effective means of protecting plants. Well-adapted, disease-resistant varieties should always be used where available and be combined with good cultural practices, such as crop rotation, planting disease- free seed, residue management, and optimal planting dates. Additionally, good crop scouting will help producers make sound decisions about when to apply fungicides as the need arises. Although there is little research on disease thresholds in oilseed crops, fungicide application for sunflower rust management is most likely economical when average disease severity reaches one percent on the upper four fully expanded leaves at or before bloom (R5).

It is important to remember that fungicides are active only against fungi and do not directly protect against bacterial, viral diseases or abiotic stresses. Therefore, proper diagnosis of the disease will save the producer from unnecessary fungicide applications. For assistance with diagnosis, send samples for diagnosis to the SDSU Plant Diagnostic Clinic (605-688-5545).

Fungicide Resistance Management
Resistance to fungicides can develop in pathogen populations under certain conditions. When selection pressure is placed on fungi through repeated applications of a single mode product, the population may develop reduced sensitivity to those chemicals. This can happen very quickly if repeated applications are made in a single season. Strobilurin fungicides (QoIs, Group 11) seem to be especially prone to this effect, while triazoles (DMIs, Group 3) have somewhat less risk of inducing resistance. The carbamate and organochlorine protectant fungicides have multi-site modes of action and have much lower risk of triggering or inducing resistance. To reduce the risk of fungicide resistant pathogens emerging, adopt a fungicide resistance management strategy, which includes the following practices:

- Apply fungicides only when necessary to prevent or treat fungal diseases.
- Only apply at recommended rates.
- Use integrated disease management to reduce the number of necessary applications.
- Avoid repeated applications of the same product or mode-of-action to the same field.
- Use strobilurins only as preventatives when initial disease is noticed, and conditions favor further disease development.
- Strobilurins should represent no more than 30–50% of total number of applications to a site.

The following is a list of fungicides labeled for use in South Dakota at the time of publication. The list is dynamic and is not exhaustive and should not be considered a substitute for label information. Always read and follow label directions for approved uses of these products and check with the South Dakota Department of Agriculture and Natural Resources for up-to-date product registration information (https://apps.sd.gov/doa/cat/prsproductsearch.aspx?type=prs).

The products in this chapter are presented as follows:

Trade name(s) (Chemical common name) Mode of action: Group code (chemical class)

Additional resources regarding pesticide safety can be found at:

- IRAC Insecticide Resistance Action Committee (http://www.irac-online.org/modes-of-action/)
- EPA United States Environmental Protection Agency (https://www.epa.gov/pesticide-worker-safety)
- South Dakota Department of Agriculture and Natural Resources (https://danr.sd.gov/Agriculture/default.aspx)
- Kelley Solutions (https://www.kellysolutions.com/SD/searchbychem.asp)

Fungicide FRAC Codes and Group Names

FRAC Code	Group Name
3	Demethylation inhibitors (DMI)
7	Succinate dehydrogenase inhibitors (SDHI)
11	Quinone outside inhibitors (QoI)
BM02	Biological with multiple modes of action

Product Table of Contents

Sunflower

Canola

Flax

Safflower

Check list of diseases controlled by each foliar fungicide

Product Name(s)	Sunflower			Canola			Flax	Safflower		
	Alternaria	Rust	White mold (suppression)	Alternaria black spot	Black-leg	White mold	Pasmo/Septoria	Alternaria leaf spot	Rust	White Mold
Azoxystrobin *(Aframe, Azoxy 2SC, Quadris, Satori, Tetraban)*	+	+	-	+	+	+	+	+	-	-
Picoxystrobin *(Aproach)*	+	+	+	+	+	+	-	-	-	+
Coniothyrium minitans strain CON/M/91-08 *(Contans WG)*	-	-	+	-	-	+	-	-	-	+
Azoxystrobin + **Benzovindiflupr** *(Elatus)*	-	-	-	+	+	-	-	-	-	-
Boscalid *(Endura)*	-	-	+	-	-	+	-	-	-	-
Pyraclostrobin *(Headline, Headline SC)*	+	+	-	+	+	-	+	+	-	-
Fluopyram + **Tebuconazole** *(Luna Experience)*	+	+	+	-	-	-	-	-	-	+
Tebuconazole *(Monsoon, Onset 3.6L, Tebuconazole 3.6F, Tebu-Crop 3.6F, TebuStar 3.6L, Tebuzol 3.6F, Toledo 3.6F)*	-	+	-	-	-	-	-	-	-	-
Tebuconazole *(Orius 3.6F)*	-	-	-	-	-	-	-	-	-	-
Fluxapyroxad + **Pyraclostrobin** *(Priaxor Xemium)*	+	+	+	+	+	+	+	+	-	+
Prothioconazole *(Proline 480 SC)*	-	-	-	-	-	+	-	-	-	-
Fluopyram + **Prothioconazole** *(ProPulse)*	+	+	+	+	-	+	-	-	-	+
Mefentrifuconazole *(Provysol)*	-	-	-	+	+	-	-	-	-	-
Metaconazole *(Quash)*	-	+	+	-	-	+	-	-	+	-
Mefentrifluconazole + **Pyraclostrobin** + **Fluxapyroxad** *(Rvytek)*	-	-	-	+	+	+	-	-	-	-
Bacillus subtilis **QST 713** *(Serenade ASO, Serenade MAX, Serenade OPTI)*	-	+	+	-	-	+	-	+	-	+
Mefentrifluconazole + **Pyraclostrobin** *(Veltyma)*	+	+	-	+	+	-	-	+	+	-
Penthiopyrad *(Vertisan)*	+	+	+	+	-	+	-	+	-	+
Picoxystrobin + **Prothioconazole** *(Viatude)*	-	-	-	+	+	+	-	-	-	-

+ = provides protection

- = does not provide protection

Sunflower

Aframe, Azoxy 2SC, Quadris, Satori, Tetraban *(azoxystrobin)* Mode of Action: 11 (QoI)

Application rate: 6 – 15.5 fl oz/A

Targeted diseases: Rust *(Puccinia helianthi)*, Alternaria *(Alternaria spp.)*, Downy Mildew *(Plasmopara halstedii)* (aerial inoculum)

REI: 4 hours

Restrictions: Apply 6.0 fl oz/A at early bud followed by 14 fl oz/A at about 45 days before harvest. A third application of 7 fl oz/A can be made at 30 days before harvest..

Do not apply within 30 days of harvest. Do not apply more than 24 fl oz/A/year for Aframe, Quadris, Satori or 27 fl oz/A/season for Azoxy 2SC and Tetraban. Minimum 14-day application interval. Do not apply more than two applications of Quadris, Aframe, Azoxy 2SC, Satori, or Tetraban without alternating with a fungicide that has a different mode of action for at least one application. Do not apply more than one application at the high rate (15.5 fl oz/A) or 4 applications per year at the low rate (6.0 fl oz/A).

Aframe, Quadris, Azoxy 2SC, Satori, and Tetraban may be applied by ground, air or chemigation. Apply a minimum of 10 gal/A by ground

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Contains WG *(Coniothyrium minitans strain CON/M/91-08)* Mode of Action: Biological control, acts on resting sclerotia of white mold pathogen.

Application rate: 1 – 4 lbs/A

REI: 4 hours

Target diseases: White mold *(Sclerotinia sclerotiorum)*.

Restrictions: Apply Contans WG to the soil at a rate of 1 – 4 lbs per acre per application 7 days prior to planting, at planting, or soon after planting followed by 1 – 4 lbs/A 14 to 21 days after first spray. Make broadcast applications and incorporate Contans WG into the top two inches of soil by light mechanical incorporation or by irrigation or rainfall soon after application. If incorporation will displace the soil greater than two inches, increase the application rate to 3 – 6 lbs per acre. Contans WG may also be applied to plant debris that remains in the field after harvest, prior to replant of a susceptible crop. Make no more than eight applications of Contans WG per season or per year, at labelled rates, as required to maintain disease control..

This product may be applied the day of harvest. Do not tank mix Contans WG with pesticides, acids, alkalines or any product that attracts organic material. Do not apply Contans WG within 7 days before or after use of other fungicide products. Rotation with other fungicides is allowed after 3 weeks following an application of Contans WG.

Endura *(boscalid)* Mode of Action: 7 (SDHI)

Application rate: 6 – 9 fl oz/A

REI: 12 hours

Targeted diseases: For suppression of white mold *(Sclerotinia sclerotiorum)*.

Restrictions: Apply prior to disease development and continue on a 7 – 14-day interval if conditions are favorable for disease. Use the higher rate and shorter intervals when disease pressure is high.

Do not apply within 21 days of harvest. Do not apply more than 18 oz of product/A per year. Do not apply more than two applications per year. No restrictions on livestock grazing or feeding.

Headline, Headline SC *(pyraclostrobin)* Mode of Action: 11 (QoI)

Application rate: 6 – 12 fl oz/A

REI: 12 hours

Targeted diseases: Rust (*Puccinia elianthin)*, Powdery mildew (*Erysiphe cichoracearum*), Alternaria (*Alternaria spp*.), Downy Mildew (*Plasmopara halstedii)* (aerial inoculum)

Restrictions: Apply prior to disease development and continue on a 7 – 14-day interval if conditions are favorable for disease. Use the higher rate and shorter intervals when disease pressure is high.

Do not apply within 21 days of harvest. Do not make more than 2 applications of Headline/year without alternating with a fungicide that has a different mode of action for at least one application. Adjuvants may be used with Headline and Headline SC. Do not apply more than 24 fl oz/A per year.

Luna Experience *(fluopyram + tebuconazole)* Mode of Action: 11 (QoI)

Application rate: 9 – 12.8 fl oz/A

REI: 12 hours

Targeted diseases: Rust *(Puccinia helianthi)*, Alternaria *(Alternaria spp.)*, Powdery mildew *(Erysiphe cichoracearum)*, Sclerotinia wilt and head rot *(Sclerotinia sclerotiorum)*.

Restrictions: Apply prior to disease development and continue as needed on a 14-day interval. Use the higher rate when disease pressure is high.

Do not apply within 50 days of harvest. Do not apply more than 34 fl oz of Luna Experience per acre per year. Do not make more than two sequential applications of Luna Experience. Apply using ground, aerial or chemigation equipment.

Monsoon, Onset 3.6L, Tebuconazole 3.6F, Tebu-Crop 3.6F, Tebustar 3.6L, Tebuzol 3.6F, Toledo 3.6F *(tebuconazole)* Mode of Action: 3 (DMI)

Application rate: 4–6 fl oz/A

REI: 12 hours

Targeted diseases: Rust *(Puccinia helianthi)*.

Restrictions: Apply at first visible signs of disease or when conditions are favorable for disease. Apply higher rate to highly susceptible varieties and/or under severe disease conditions. Repeat applications on a 14-day interval if conditions are favorable for disease. Apply specified dosage in a minimum of 20 gallons of spray solution per acre by ground or a minimum of 5 gallons spray solution by air. Must have 2-4 hours of drying time before rain or irrigation.

Do not apply within 50 days of harvest. Do not apply more than 16 fl oz/A per season.

Priazor Xemium *(fluxapyroxad + pyraclostrobin)* Mode of Action: 7, 11 (SDHI, QoI)

Application rate: 4 – 8 fl oz/A

REI: 12 hours

Targeted diseases: Rust *(Puccinia helianthi)*, Alternaria *(Alternaria spp.)*. Suppression only: Sclerotinia head blight *(Sclerotinia sclerotiorum)*.

Restrictions: Apply prior to disease development and continue on a 7 – 14-day interval if conditions are favorable for disease. Use the higher rate and shorter intervals when disease pressure is high.

Do not apply within 21 days of harvest. Do not apply more than two applications of Priaxor without alternating with a fungicide that has a different mode of action for at least one application. Max applications per year for Priaxor is 2.

Priaxor may be applied by ground, air or chemigation. Adjuvants may be used with Priaxor. Do not apply more than 16 fl oz/A per year. No livestock feeding restrictions.

Quash *(metconazole)* Mode of Action: 3 (DMI)

Application rate: 2.5 – 4 fl oz/A

REI: 12 hours

Targeted diseases: Rust *(Puccinia helianthi)*, Suppression: White mold *(Sclerotinia sclerotiorum)*.

Restrictions: Apply when conditions favor disease development. A second application may be made on a 7 – 14-day interval. Do not apply within 21 days of harvest. Do not apply more than 8 oz of product/A per year. Do not apply more than two applications per year. A PF5 respirator is required when mixing/loading for use on sunflower. No livestock feeding or grazing restrictions.

Serenade ASO, Serenade Max, Serenade OPTI *(Bacillus subtilis strain QST 713)* Mode of Action: BM02 (Biological with multiple modes of action) (fungicidal lipopeptides)

Serenade ASO application rate: 2 – 4 qts/A
Serenade MAX application rate: 1 – 3 lbs/A
Serenade OPTI application rate: 14 – 20 oz/A

REI: 4 hours

Targeted diseases: Rust (*Puccinia spp.*); For suppression of white mold (*Sclerotinia sclerotiorum*).

Restrictions: Apply after emergence and when conditions are favorable for disease and repeat on a 7 – 10-day interval or as needed. Use the higher rate and shorter intervals when disease pressure is high.

Serenade ASO, MAX and Opti may be applied by ground, air or chemigation.

Vertisan *(penthiopyrad)* Mode of Action: 7 (SDHI)

Application rate: 10 – 30 fl oz/A
Application rate: 16 – 30 fl oz/A (white mold)

REI: 12 hours

Targeted diseases: Rust *(Puccinia helianthi)*, Alternaria *(Alternaria spp.)*, Powdery mildew *(Erysiphe cichoracearum)*, White mold *(Sclerotinia sclerotiorum)*.

Restrictions: Apply before disease occurs and repeat on a 7 – 14-day interval. Use the higher rate and shorter interval when disease pressure is high.

Do not apply within 14 days of harvest. Do not apply more than two sequential applications of Vertisan without alternating with another fungicide chemistry.

Apply a minimum of 2 gal/A by air or 10 gal/A ground. Do not apply more than 61 fl oz/A/season.

Veltyma *(mefentrifluconazole + pyraclostrobin)* Mode of Action: 3, 11 (DMI, QoI)

Application rate: 7 – 10 fl oz/A

REI: 12 hours

Targeted diseases: Alternaria *(Alternaria spp.)*, Powdery Mildew *(Erysiphe spp.)*, Rust *(Puccinia spp.)*

Blackspot: apply at early pod development.

Restrictions: Do not apply within 21 days of harvest. Do not apply more than two applications of Veltyma per acre per year. Max application rate is 20 fl oz/A/year. Veltyma can be applied by ground, air, or chemigation.

Canola

Aframe, Azoxy 2SC, Quadris, Satori, Tetraban *(azoxystrobin)* Mode of Action: 11 (QoI)

Application rate: 6 – 15.5 fl oz/A

REI: 4 hours

Targeted diseases: Alternaria black spot *(Alternaria spp.)*, Black-leg *(Leptoshaeria maculans)*, White mold *(Sclerotinia sclerotiorum)*.

Restrictions: Alternaria black spot and white mold: apply 9.0 – 15.5 fl oz/A at 10 – 25% flowering (3 – 7 days following first flower). Apply at the 2 – 4 leaf stage for black-leg. For control of Alternaria alone, 8.0 fl oz/A may be applied at pod stage (approximately 95% petal fall). Use the higher rate when disease pressure is high or if conditions are favorable for disease.

Do not apply within 30 days of harvest. Do not apply more than 24 fl oz/A/year for Aframe, Quadris, and Satori or 27.6 fl oz/A/season for Tetraban. Do not apply more than one application of Quadris, Aframe, Azoxy 2SC, Satori, or Tetraban without alternating with a fungicide that has a different mode of action for at least one application. Do not apply more than one application at the high rate (15.5 fl oz/A) or 4 applications per year at the low rate (6.0 fl oz/A).

Quadris, Aframe, Azoxy 2SC, Satori, and Tetraban may be applied by ground, air or chemigation. Apply a minimum of 10 gal/A by ground.

Aproach *(picoxystrobin)* Mode of Action: 11 (QoI)

Application rate: 6 – 12 fl oz/A
Application rate for Sclerotinia stem rot: 8 – 12 fl oz/A

REI: 12 hours

Targeted diseases: Alternaria black spot *(Alternaria spp.)*, Black-leg *(Leptoshaeria maculans)*, White mold *(Sclerotinia sclerotiorum)*.

Restrictions: For Alternaria black spot and Black-leg, apply before disease occurs and repeat on a 7 – 14-day interval. Use the higher rate and shorter interval when disease pressure is high.

For white mold, apply at 20 – 50% bloom stage prior to disease onset and continue on a 7 – 14-day interval. Use the higher rate and shorter interval when disease pressure is high.

Do not apply within 28 days of harvest. Do not apply more than two sequential applications of Aproach without alternating with another fungicide chemistry. Do not apply more than 24 fl oz/A/year, max of 2 applications/season. Aproach may be applied with ground, air, or chemigation.

Contains WG *(Coniothyrium minitans strain CON/M/91-08)* Mode of Action: Biological control, acts on resting sclerotia of white mold pathogen.

Application rate: 1 – 4 lb./A

REI: 4 hours

Target diseases: White mold *(Sclerotinia sclerotiorum)*.

Restrictions: Apply Contans WG to the soil at a rate of 1 – 4 lbs per acre per application 7 days prior to planting, at planting, or soon after planting followed by 1 – 4 lbs/A 14 to 21 days after first spray. Make broadcast applications and incorporate Contans WG into top two inches of soil by light mechanical incorporation or by irrigation or rainfall soon after application. If incorporation will displace the soil greater than two inches, increase the application rate to 3 – 6 lbs per acre. Contans WG may also be applied to plant debris that remains in the field after harvest, prior to replant of a susceptible crop. Make no more than eight applications of Contans WG per season or per year, at labelled rates, as required to maintain disease control.

This product may be applied the day of harvest. Do not tank mix Contans WG with pesticides, acids, alkalines or any product that attracts organic material. Do not apply Contans WG within 7 days before or after use of other fungicide products. Rotation with other fungicides is allowed 3 weeks following an application of this product.

Elatus *(azoxystrobin + benzovindiflupyr)* Mode of Action: 11, 7 (QoI, SDHI)

Application rate: 7.3 fl oz/A

REI: 12 hours

Targeted diseases: Alternaria black spot *(Alternaria brassicae)*, Blackleg/Phoma *(Leptoshaeria maculans)*, Cercosproa leaf spot *(Cercospora brassicicola)*, Head rot *(Rhizoctonia solani)*, Leaf spot and pod rot *(Alternaia alternata)*, Powdery mildew *(Erysiphe polygoni)*.

Restrictions: For Phoma control, apply during the rosette stage between 2nd true leaf and bolting. For Alternaria, make an application at the end of flowering/early pod set. For head rot, apply at 50% flowering. For other diseases, apply at first sign of disease. Make no more than one Elatus application per year.

Do not apply more than 7.3 oz/A/year. Do not apply within 30 days of harvest. Elatus may be applied by ground, air, or chemigation.

Endura *(boscalid)* Mode of Action: 7 (SDHI)

Application rate: 5 – 6 fl oz/A

REI: 12 hours

Targeted diseases: White mold *(Sclerotinia sclerotiorum)*.

Restrictions: Apply at 20 – 50% bloom stage or prior to disease onset. Use the higher rate for extended protection. Apply a second time if conditions are favorable for disease.

Do not apply within 21 days of harvest. Do not apply more than 12 oz of product/A per year. Do not apply more than two applications per year. There are no restrictions for livestock grazing or feeding. Endura may be applied by ground, air, or chemigation.

Headline, Headline SC *(pyraclostrobin)* Mode of Action: 11 (SDHI)

Application rate: 6 – 12 fl oz/A

REI: 12 hours

Targeted diseases: Alternaria black spot *(Alternaria spp.)*, Black-leg *(Leptoshaeria maculans)*.

Restrictions: For black-leg, apply at 2 – 4 leaf stage. For optimal control of black spot, apply Headline at early pod development. Make a second application 7 – 10 days later if disease persists or if conditions are favorable for disease. Use the higher rate and shorter intervals when disease pressure is high.

Do not apply within 21 days of harvest. Do not apply more than two applications of Headline, Headline SC without alternating with a fungicide that has a different mode of action for at least one application. Adjuvants may be used with Headline and Headline SC. Do not apply more than 24 fl oz/A per year. Headline, Headline SC may be applied by ground, air, or chemigation. No livestock feeding restrictions.

Priaxor Xemium *(fluxapyroxad + pyraclostrobin)* Mode of Action: 7, 11 (SDHI, QoI)

Application rate: 4 – 8 fl oz/A

REI: 12 hours

Targeted diseases: Alternaria black spot *(Alternaria spp.)*, Black-leg *(Leptoshaeria maculans)*, Suppression only: White mold *(Sclerotinia sclerotiorum)*.

Black-leg: Apply at the 2 – 4 leaf stage. A second application can be made 14 days later if conditions are favorable for disease.

White mold: For suppression apply at 20 – 50% bloom stage or prior to disease onset. A second application can be made 14 days later if conditions are favorable for disease.

Alternaria black spot: apply at early pod development. A second application can be made 14 days later if conditions are favorable for disease.

Restrictions: Do not apply within 21 days of harvest. Do not apply more than two applications of Priaxor without alternating with a fungicide that has a different mode of action for at least one application. There are no livestock feeding restrictions. Do not make more than 2 applications per year and do not exceed 16 fl oz/A/year. Priaxor may be applied by ground, air or chemigation..

Proline 480 SC *(prothioconazole)* Mode of Action: 3 (DMI)

Application rate: 4.3 – 5.7 fl oz/A

REI: 12 hours

Targeted diseases: White mold *(Sclerotinia sclerotiorum)*.

Restrictions: White mold: apply at 20 – 50% bloom stage and continue on a 14-day interval if conditions are favorable for disease. The best protection will be achieved when Proline is applied prior to petals beginning to fall. Use the higher rate where fields with a history of heavy disease pressure or for dense crop stands.

Do not apply within 36 days of harvest. Do not apply more than 11.4 fl oz/A/year. Proline may be applied by ground, air or chemigation. Proline may be applied until the 50% bloom stage. Max application of 2 times per year.

Propulse *(fluopyram + prothioconazole)* Mode of Action: 7, 11 (SDHI, QoI)

Application rate: 9.0 fl oz/A

REI: 12 hours

Targeted diseases: White mold *(Sclerotinia schlerotiorum)*, Powdery mildew *(Erysiphe cruciferarum)* Alternaria black spot *(Alternaria spp.)*

Restrictions: Apply at the 20 – 50% bloom stage. Best protection will be achieved when Propulse is applied prior to petals beginning to fall. Continue as needed on a 14-day interval if conditions are favorable for disease. Do not apply more than 18.0 fl oz/acre per year. Maximum single application rate is 9.0 fl oz/acre. Do not apply more than 0.269 lbs fluopyram or 0.356 lbs prothioconazole per acre per year from all uses, including seed treatment, soil and foliar applications.

Apply by ground, air, or chemigation application equipment. Do not apply Propulse within 36 days of harvest. Do not apply more than 2 times/year. Do not use with handheld application equipment, including mechanically pressurized spray gun, backpack or tank pressurized spray gun, or handheld boom applicators.

Provysol *(mefentrifluconazole)* Mode of Action: 3 (DMI)

Application rate: 2.5 – 5 fl oz/A

REI: 12 hours

Targeted diseases: Alternaria black spot *(Alternaria spp.)*, Blackleg *(Leptoshaeria maculans)*

Blackleg: Apply at 2- to 4-leaf stage; Blackspot: Apply at early pod development.

Restrictions: Do not apply more than 5 fl oz/acre per application. Do not apply more than 10 fl oz/A per year. Apply at 14-day intervals. Pre-harvest interval is 21 days. Provysol can be applied by ground, air, or chemigation.

Quash *(metconazole)* Mode of Action: 3 (DMI)

Application rate: 2 – 4 fl oz/A

REI: 12 hours

Targeted diseases: White mold *(Sclerotinia sclerotiorum)*.

Restrictions: Apply at 20 – 50% bloom stage. Under high disease pressure, use the 4 oz/A rate.

Do not apply within 35 days of harvest. Do not apply more than 4 oz of product/A per year. Do not apply more than one application per year. A PF5 respirator is required when mixing/loading product for use on canola.

Quash can be applied by ground air, or chemigation.. Apply a minimum of 10 – 20 gal/A by ground or 5 gal/A by air. No livestock grazing or feeding restrictions.

Revytek *(mefentrifluconazole + pyraclostrobin + fluxapyroxad)* Mode of Action: 3, 7, 11 (DMI, SDHI, QoI)

Application rate for Blackleg and Blackspot: 8 – 15 fl oz/A
Application rate for White Mold: 15 fl oz/A

REI: 12 hours

Targeted diseases: Blackleg *(Leptoshaeria maculans)*, Blackspot *(Alternaria spp.)*, White mold/Sclerotinia stem rot *(Sclerotinia sclerotiorum)*

Apply at 14-day intervals. For Blackleg: apply at the 2-leaf to 4-leaf stage. For Blackspot: apply at early pod development. For Sclerotinia: apply before disease develops or at 20 – 50% flowering. A second application may be made 14 days later if weather conditions are favorable for disease

Restrictions: Do not apply more than 15 fl oz per acre per application. Do not make more than 2 applications per acre per year. Do not apply more than 30 fl ozs per acre per year. Revytek may be applied by ground, air or through chemigation.

Serenade ASO, Serenade Max, Serenade OPTI *(Bacillus subtilis strain QST 713)* Mode of Action: BM02 (biological)

Serenade ASO application rate: 2 – 4 qts/A
Serenade MAX application rate: 1 – 3 lbs/A
Serenade OPTI application rate: 14 – 20 oz/A

REI: 4 hours

Targeted diseases: For suppression only of white mold *(Sclerotinia sclerotiorum)*.

Restrictions: Apply after emergence and when conditions are favorable for disease and repeat on a 7 – 10-day interval or as needed. Use the higher rate and shorter intervals when disease pressure is high.

Serenade ASO, Max, and Opti have a 0-day pre-harvest interval and can be applied by ground, air or chemigation.

Veltyma *(mefentrifluconazole + pyraclostrobin)* Mode of Action: 3, 11 (DMI, QoI)

Application rate: 7 – 10 fl oz/A

REI: 12 hours

Targeted diseases: Alternaria black spot *(Alternaria spp.)*, Blackleg *(Leptoshaeria maculans)*.

Blackleg: apply at 2-leaf to 6-leaf stage.

Blackspot: apply at early pod development.

Restrictions: Do not apply within 21 days of harvest. Do not apply more than two applications of Veltyma per acre per year. Max application rate is 20 fl oz/A/season.

Vertisan *(penthiopyrad)* Mode of Action: 7 (SDHI)

Application rate: 14 – 20 fl oz/A
Application rate for white mold: 16 – 20 fl oz/A

REI: 12 hours

Targeted diseases: Alternaria black spot *(Alternaria spp.)*, White mold *(Sclerotinia sclerotiorum)*.

White mold: Apply at 20 – 50% bloom stage or prior to disease onset and continue on a 7 – 14-day interval. Use the higher rate and shorter interval when disease pressure is high.

Alternaria black spot: Apply before disease occurs and repeat on a 7 – 14-day interval. Use the higher rate and shorter interval when disease pressure is high..

Restrictions: Do not apply within 21 days of harvest. Do not apply more than two sequential applications of Vertisan without alternating with another fungicide chemistry. Apply a minimum of 2 gal/A by air,10 gal/A for air-assisted ground application, or a minimum of 15 gallons per acre for conventional ground application. Do not apply more than 41 fl oz/A/year.

Viatude *(picoxystrobin + prothioconazole)* Mode of Action: 11, 3 (QoI, DMI)

Application rate: 8 – 16 fl oz/A
Application rate for white mold: 10 – 16 fl oz/A

REI: 24 hours

Targeted diseases: Alternaria blackspot, leaf and stem spots *(Alternaria spp.)*, Blackleg *(Leptosphaeria maculans)*, White mold *(Sclerotinia sclerotiorum)*

Alternaria and blackleg: Begin applications prior to disease development and make a second application on a 14-day interval. Use the higher rate when disease pressure is high.

White mold: Begin applications at 20 – 50% bloom or prior to the onset of disease on a 14-day interval. Use the higher rate when conditions are favorable for disease development.

Restrictions: Do not apply more than 16 fl oz per acre per application. Do not make more than two sequential applications of Viatude without alternating with another fungicide chemistry. Do not apply more than a total of 32 fl oz/A per year. Do not apply within 36 days of harvest.

Flax

Aframe, Azoxy 2SC, Quadris, Satori, Tetraban *(azoxystrobin)* Mode of Action: 11 (QoI)

Application rate: 6 – 15.5 fl oz/A

REI: 4 hours

Targeted diseases: Pasmo *(Septoria linicola)*.

Restrictions: Apply 6.0 fl oz/A at early bud followed by 14 fl oz/A at about 45 days before harvest. A third application of 7 fl oz/A can be made at 30 days before harvest.

Aframe, Azoxy 2SC, Quadris, Satori, and Tetraban may be applied by ground, air or chemigation. Apply a minimum of 10 gal/A by ground. Do not apply more than 24 fl oz/A/season for Aframe, Quadris, and Satori and 27 fl oz/A/season for Azoxy 2SC, and Tetraban. Do not apply more than two sequential applications of Aframe, Azoxy 2SC, Quadris, Satori, or Tetraban without alternating with another fungicide chemistry. Do not apply more than one application at the high rate (15.5 fl oz/A) or 4 applications per year at the low rate (6.0 fl oz/A).

Pre-harvest interval is 30 days. Aframe, Azoxy 2SC, Quadris, and Satori have a 4 applications/ season limit.

Headline, Headline SC *(pyraclostrobin)* Mode of Action: 11 (QoI)

Application rate: 6 – 12 fl oz/A

REI: 12 hours

Targeted diseases: Pasmo *(Septoria linicola)*.

Restrictions: Apply at mid-flowering (7 – 10 days after flowering starts). Make a second application 7 – 10 days later if disease persists or if conditions are favorable for disease. Use the higher rate and shorter intervals when disease pressure is high

Do not apply within 21 days of harvest. Do not apply more than two applications of Headline and Headline SC without alternating with a fungicide that has a different mode of action for at least one application. Adjuvants may be used with Headline and Headline SC. There are no livestock feeding restrictions. Do not apply more than 24 fl oz/A per year. Headline has a max application of 2/year.

Priaxor Xemium *(fluxapyroxad + pyraclostrobin)* Mode of Action: 7, 11 (SDHI, QoI)

Application rate: 4 – 8 fl oz/A

REI: 12 hours

Targeted diseases: Pasmo *(Septoria linicola)*.

Restrictions: Apply prior to disease development and continue on a 7 – 14-day interval if conditions are favorable for disease. Use the higher rate and shorter intervals when disease pressure is high. Priaxor may be applied by ground, air or chemigation. Adjuvants may be used with Priaxor.

Do not apply more than two applications of Priaxor without alternating with a fungicide that has a different mode of action for at least one application. There are no livestock feeding restrictions. Do not make more than 2 applications per year and do not exceed 16 fl oz/A/year.

Quash *(metconazole)* Mode of Action: 3 (DMI)

Application rate: 2 – 4 fl oz/A

REI: 12 hours

Targeted diseases: White mold *(Sclerotinia sclerotiorum)*.

Restrictions: Apply at 20 – 50% bloom stage. Under high disease pressure, use the 4 oz/A rate.

Do not apply within 35 days of harvest. Do not apply more than 4 oz of product/A per year. Do not apply more than one application per year.

Apply a minimum of 10 – 20 gal/A by ground or 5 gal/A by air.

Safflower

Aframe, Azoxy 2SC, Quadris, Satori, Tetraban *(azoxystrobin)* Mode of Action: 11 (QoI)

Application rate: 6 – 15.5 fl oz/A

REI: 4 hours

Targeted diseases: Alternaria leaf spot *(Alternaria spp.)*.

Restrictions: Apply 6.0 fl oz/A at early bud followed by 14 fl oz/A at about 45 days before harvest. A third application of 7 fl oz/A can be made at 30 days before harvest.

Do not apply within 30 days of harvest. Do not apply more than two sequential applications of Aframe, Azoxy 2SC, Quadris, Satori, or Tetraban without alternating with another fungicide chemistry. Do not apply more than 24 fl oz/A/season for Aframe, Quadris, and Satori or 27 fl oz/A per season for Azoxy 2SC and Tetraban. Do not apply more than one application at the high rate (15.5 fl oz/A) or 4 applications per year at the low rate (6.0 fl oz/A).

Use only in an integrated disease management approach with resistant hybrids, proper fertility, residue management and crop rotation. Aframe, Azoxy 2SC, Quadris, Satori, and Tetraban may be applied by ground, air or through chemigation. Use a minimum of 10 gal/A for ground applications.

Headline, Headline SC *(pyraclostrobin)* Mode of Action: 11 (QoI)

Application rate: 6 – 12 fl oz/A

REI: 12 hours

Targeted diseases: Alternaria leaf spot *(Alternaria spp.)*.

Restrictions: Apply prior to disease development and continue on a 7 – 14-day interval if conditions are favorable for disease. Use the higher rate and shorter intervals when disease pressure is high.

Do not apply within 21 days of harvest. Do not apply more than two applications of Headline and Headline SC without alternating with a fungicide that has a different mode of action for at least one application. No livestock feeding requirements.

Adjuvants may be used with Headline and Headline SC. Do not apply more than 24 fl oz/A per season. Headline has a max of 2 applications/season.

Priaxor Xemium *(fluxapyroxad + pyraclostrobin)* Mode of Action: 7, 11 (SDHI, QoI)

Application rate: 4 – 8 fl oz/A

REI: 12 hours

Targeted diseases: Alternaria leaf spot (*Alternaria spp.*); Suppression only of White mold (*Sclerotinia sclerotiorum*).

Restrictions: Apply prior to disease development and continue on a 7 – 14-day interval if conditions are favorable for disease. Do not apply within 21 days of harvest. Do not apply more than two applications of Priaxor without alternating with a fungicide that has a different mode of action for at least one application.

Priaxor may be applied by ground, air or through chemigation. Do not apply more than 16 fl oz/A per season. Do not apply more than two applications per season. There is no livestock feeding restrictions.

Quash *(metconazole)* Mode of Action: 3 (DMI)

Application rate: 2.5 – 4 fl oz/A

REI: 12 hours

Targeted diseases: Rust *(Puccinia helianthi)*, White mold *(Sclerotinia sclerotiorum)*.

Restrictions: Apply when conditions favor disease development. A second application may be made on a 7 – 14-day interval. Do not apply within 21 days of harvest. Do not apply more than 8 oz of product/A per year. Do not apply more than two applications per year..

Vertisan *(penthiopyrad)* Mode of Action: 7 (SDHI)

Application rate: 10 – 30 fl oz/A
Application rate: 16-30 fl oz/A Sclerotinia stem rot

REI: 12 hours

Targeted diseases: Alternaria black spot (*Alternaria spp.*), Sclerotinia stem rot (*Sclerotinia spp.*)

Restrictions: Alternaria black spot: apply before disease occurs and repeat on a 7 – 14-day interval. Use the higher rate and shorter interval when disease pressure is high.

Do not apply within 14 days of harvest. Do not apply more than two sequential applications of Vertisan without alternating with another fungicide chemistry. Do not apply more than 61 fl oz/A/year.

Veltyma *(mefentrifluconazole + pyraclostrobin)* Mode of Action: 3, 11 (DMI, QoI)

Application rate: 7 – 10 fl oz/A

REI: 12 hours

Targeted diseases: Alternaria black spot *(Alternaria spp.)*, Rust *(Puccinia spp.)*, and Blackspot: apply at early pod development.

Restrictions: Do not apply within 21 days of harvest. Do not apply more than two applications of Veltyma per acre per year. Max application rate is 20 fl oz/A/year.